PHILADELPHIA CRASH ANALYSIS STANDARDS & RECOMMENDATIONS

DELAWARE VALLEY
dvrpc
REGIONAL
PLANNING COMMISSION

JANUARY 2018

The Delaware Valley Regional Planning Commission is the federally designated Metropolitan Planning Organization for a diverse nine-county region in two states: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey.

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

DVRPC's vision for the Greater Philadelphia Region is a prosperous, innovative, equitable, resilient, and sustainable region that increases mobility choices by investing in a safe and modern transportation system; that protects and preserves our natural resources while creating healthy communities; and that fosters greater opportunities for all.

DVRPC's mission is to achieve this vision by convening the widest array of partners to inform and facilitate data-driven decision-making. We are engaged across the region, and strive to be leaders and innovators, exploring new ideas and creating best practices.

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EXECUTIVE SUMMARY

The City of Philadelphia ("the City") engaged the Delaware Valley Regional Planning Commission (DVRPC) to investigate ways to evolve the analysis and management of crash data by City departments. City partners collaborated with DVRPC on a scope of work that would identify best practices from among peer cities to establish a consistent source of crash data and standard procedures for analyzing crashes and tracking performance. This project aligns with the City's new Vision Zero initiative, which relies heavily on crash data for identifying crash safety priorities while also coordinating City departments to make travel safer for all Philadelphians.

DVRPC's research found that City agencies currently use three distinct databases of crash data: an Access database of the Pennsylvania Department of Transportation's (PennDOT's) crash data, a geodatabase populated with the same PennDOT data, and a separate geodatabase populated with police crash data obtained directly from the Philadelphia Police Department (PPD) and maintained by the Philadelphia Streets Department (Streets). Each product has strengths and limitations and is relied on by different departments within the City for ongoing analysis efforts that serve varied yet specific needs, although no standards have been established to guide this work. Although priorities differ citywide, there is a need for consistency in analysis methods and for shareable standardized reports.

Interviews were conducted with transportation officials from seven peer cities and two countries—all of which previously adopted Vision Zero—in order to ascertain best practices in data management and analysis. These interviews informed both the recommendations that DVRPC delivered to the City to support the Vision Zero effort and those presented in this report.

The study focused on two primary areas: analysis methodology for identifying a Vision Zero High Injury Network (HIN) and strategies to evolve Philadelphia's crash data management and analysis processes. The HIN recommendations were delivered to the City in May 2017 to inform the development of the Vision

Zero action plan, which was made public in September 2017. Five trends were identified that formed the HIN analysis recommendations: (1) analyze corridors and intersections, (2) measure killed and severe injury crashes per mile, (3) use five years of data, (4) focus on pedestrian and bicyclist crashes, and (5) compare to an existing equity index.

The crash data management and analysis recommendations are focused on three goals: centralization, standardization, and ease of use. They draw from the experiences of peer cities, particularly New York City and San Francisco, which were the first cities to adopt Vision Zero in the United States and have developed robust crash data analysis and management procedures. The report presents short-term recommendations that build upon Philadelphia's existing systems and practices and long-term recommendations that promote integration of other data types and use of more tailored database products.

Data management should be streamlined to end the proliferation of parallel crash databases. The primary short-term recommendation is to centralize all crash data in GeoDB2, the geodatabase currently used by all departments across the City. All crash data, including the police data received by Streets, should be accessible only from a single location, and GeoDB2 provides an opportunity to build on an existing strength. In addition, Vision Zero-related metrics and analysis, particularly locations identified through the HIN, should be considered by all City departments in their various safety-related work to help advance Vision Zero goals and to ensure consistency. In the longer term, Philadelphia should move to further centralize, standardize, and simplify crash analysis for departments across the City. New York City and San Francisco both offer innovative crash data management strategies that Philadelphia city officials should consider as they work to evolve the current system.

CHAPTER 1

PROJECT BACKGROUND

PROJECT SCOPE

The Philadelphia Crash Analysis Standards and Recommendations project arose because the City lacked a systematic way of tracking and analyzing crash trends in the city. There were three goals for the study:

- Research best practices in data collection and measurement as it relates to crashes.
- Propose a system for tracking and analyzing crash trends in Philadelphia.
- Identify crash trend overrepresentations in Philadelphia.

Six tasks were identified to accomplish these goals. Tasks 1 and 2 focused on gathering stakeholders within the City for a steering committee and to assist with cataloging the current state of crash data storage and analysis within the City. These tasks would culminate in a short memo covering the current systems and practices in place to assist with safety planning at departments across the City (see Chapter 2: Current State of Data Management in Philadelphia).

Tasks 3 and 4 focused on researching and surveying peer cities on best practices in crash data collection methods, data collection standards, and measurement approaches. The practices gleaned from this research would then be developed into recommendations for the City. Tasks 5 and 6 focused on the final deliverables for the project: (1) a memo examining crash overrepresentations in the City and (2) a final report incorporating all the interim deliverables.

Vision Zero

The project scope was revised following the initial stakeholder meeting to better align with the emerging goals of Philadelphia's Vision Zero initiative. Mayor Kenney launched Philadelphia's Vision Zero in the fall of 2016, shortly before the Philadelphia Crash Analysis Standards and Recommendations project kicked off. The revised scope sought to align the recommendations from the peer city research with the new Vision Zero program. Specifically, this entailed focusing best practices research on cities that had adopted Vision Zero. In addition, it increased the importance of developing crash data standards intended to identify a HIN, or a network of streets in Philadelphia overrepresented in severe crashes across the city.

The task to identify crash overrepresentations also evolved to reflect Vision Zero priorities. The memo will now reflect available data on the "Safety Six," including reckless (or aggressive) driving, red-light running, stop-sign running, impaired driving, and distracted driving. The "Safety Six" also include failure to yield and parking violations, but data is not readily available on these types of violations. This element of the project is not incorporated into this report and will be delivered as an add-on element at a later date.

CHAPTER 2

CURRENT STATE OF DATA MANAGEMENT IN PHILADELPHIA

METHODOLOGY

The information in this section is drawn from meetings held during March 2017 with Vision Zero-related committees made up of interested City and state agencies. It is organized around the two primary datasets of Philadelphia crash data produced separately by PennDOT and Streets. All reportable crash data originates from the PA AA-500 Police Crash Reporting Form, which is the form used to record the details of a reportable crash in the State of Pennsylvania. A crash is considered reportable in Pennsylvania either when a person is injured or killed, or if a vehicle requires towing from the scene.

The first meeting was conducted on **March 10, 2017**, with the City Safety Group, an ad hoc group comprised of agencies that work with crash data, including Streets, the Office of Transportation and Infrastructure Systems (oTIS), the Philadelphia City Planning Commission (PCPC), the Philadelphia Department of Public Health (PDPH), and the GIS Services Group (GSG). This meeting focused on a discussion of the flow of crash data from the time that a crash occurs to when the data is available to different City agencies.

The second meeting was conducted on **March 15, 2017**, with the Vision Zero Crash Analysis Team (CAT). This group included many of the same representatives present at the City Safety Group meeting, as well as representatives from PennDOT and the PPD. This meeting built upon the knowledge gathered at the City Safety Group meeting, including feedback on the draft flow chart produced by DVRPC (see Figure 1).

The final meeting was held on **March 30, 2017**, with the Vision Zero Evaluation and Data Subcommittee and focused on a presentation of Streets' crash data analysis tool: the Philadelphia Traffic Data Management System (PTDMS).

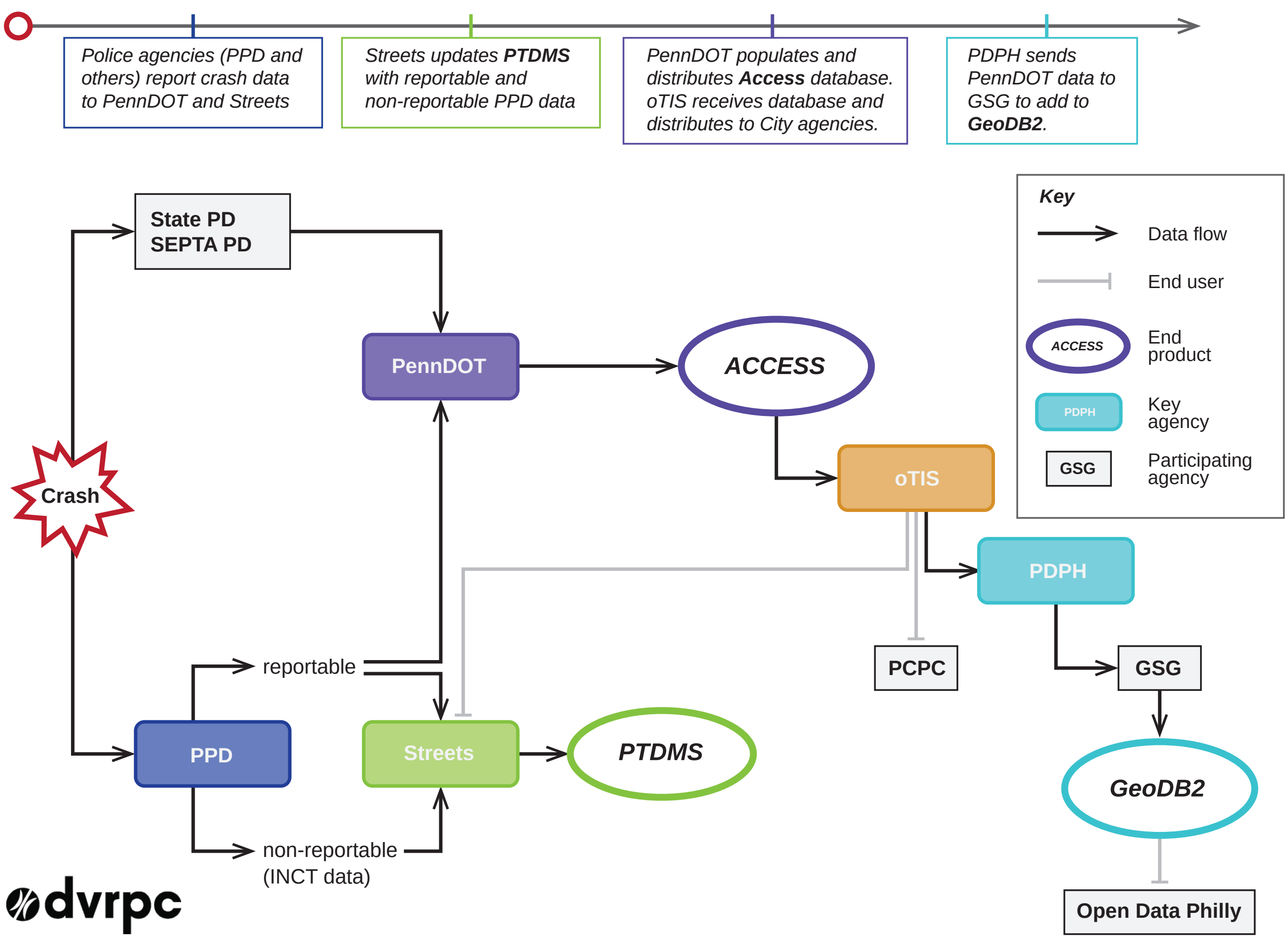
Information gathered from these meetings and documents provided to the project team by PennDOT informed the Task III Interim Deliverable, a short narrative of Philadelphia's current crash data flow and analysis. This deliverable was circulated in draft form to the stakeholders on the CAT for review, and the comments received were incorporated into the final version, presented below.

OVERVIEW OF PHILADELPHIA' S CRASH DATA PROCESS

Crash data from PPD and other crash-reporting police forces in Philadelphia travels along two parallel paths that end in three distinct databases: a PennDOT Access database, a City geodatabase called GeoDB2, and PTDMS, Streets' GIS-enabled database tool (see Figure 1).

Currently, PPD submits completed PA AA-500 crash-reporting forms to PennDOT and separately to Streets. In addition to the reportable crash data that PennDOT and Streets both receive, Streets also receives information on non-

FIGURE 1 | PHILADELPHIA CRASH DATA FLOW CHART



Source: DVRPC (2017)

reportable crashes. Streets receives both reportable and non-reportable crash data via the On-Line Incident Transmittal (INCT) system, the computerized records of all complaints, incidents, and offenses. PPD will soon implement the state's Traffic and Criminal Software (TraCS), an electronic reporting system that all other police departments in Pennsylvania currently use to record crash details and to electronically transfer the report crash data to PennDOT.

PTDMS

Both reportable and non-reportable crash data are submitted to Streets by PPD via INCT on a monthly schedule. Only select data items are received, including:

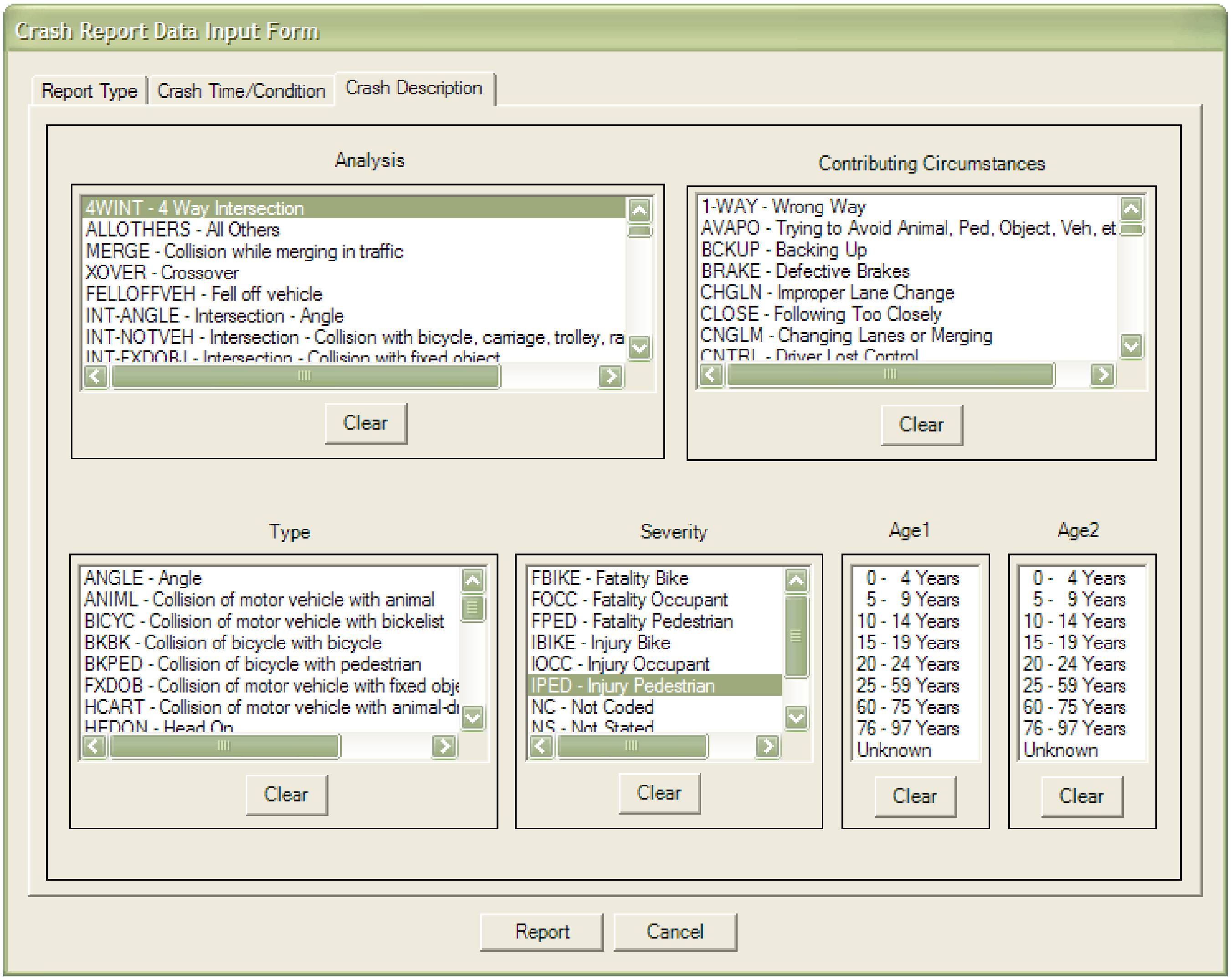
- location (longitude/latitude);
- Uniform Crime Reporting number;
- if the crash was reportable; and
- number of injuries or fatalities.

Streets also receives data recorded on the PA AA-500 police crash reporting forms for reportable crashes when that information is sent to PennDOT (less frequently than INCT data). This data is received in an Excel spreadsheet. This process will be revamped with the implementation of TraCS and its electronic reporting capabilities, including more frequent data uploads from PPD to Streets. Location data for reportable crashes is quality controlled by Streets and added to PTDMS. Previously, PTDMS was provided access to complete PA AA 500 police report forms (including all data, plus narratives and diagrams where applicable) for use in analysis and to support insurance claims when utility poles are damaged in crashes. Access to diagrams and narratives has recently been removed from the system, and future access is uncertain. Should access remain closed, this could ease granting permissions to other City agencies to access PTDMS, as discussed in Chapter 4.

PTDMS provides Streets with a robust tool to analyze crash data in a GIS environment. It also easily produces standardized reports that Streets can use for project prioritization. Figure 2 shows one of three windows that a user encounters when building out a report from PTDMS. After selecting crashes in the GIS environment, PTDMS generates a report on the desired dataset, which the user defines. The tool then outputs a report summarizing the data by a variety of factors, such as number of injuries, time of day, collision type, etc.

Since PPD sends the data directly to Streets, crash data is available relatively quickly (within one to two months from the time of the crash event) and includes both reportable and non-reportable crashes. Currently, only Streets

FIGURE 2 | PTDMS CRASH REPORT DATA INPUT FORM (CRASH DESCRIPTION)



Source: Philadelphia Streets Department (2017)

has access to PTDMS, which severely limits its usefulness to other departments in the City. It also lacks any crashes reported by a police agency other than PPD. Although it is unclear what proportion of crashes is reported by non-PPD agencies in Philadelphia, it may be very low. In addition, the tool was custom-built for Streets, which has certain benefits for Streets but also drawbacks for its adaptability to other applications (like Vision Zero-related activities). For instance, PTDMS tracks fatalities and injuries but not the severity of the injuries, which is necessary to track severe injury crashes for Vision Zero-related tracking measures.

PennDOT Annual Crash Data

PennDOT receives reportable crash data directly from PPD and other local enforcement agencies like the Pennsylvania State Police and the Southeastern Pennsylvania Transportation Authority (SEPTA), which results in a more complete dataset than PTDMS. PennDOT processes the data into an Access database and then makes it available to government partners by request. Data from the previous year is typically available within five months. In 2016 PennDOT introduced public access portals to crash data, including GIS files. The Pennsylvania Crash Information Tool (PCIT) is the public gateway to the Commonwealth's crash statistics. PCIT offers standardized reports and a custom query tool.

For GIS files, PennDOT's PennShare Open Data Portal (http://data-pennshare.opendata.arcgis.com/) offers many transportation-related datasets for download, including crash data in .csv format for years 1997–2016. Data can be downloaded by county or for the entire state. Access via PennShare has made the crash data request process obsolete for those government agencies that are proficient with GIS.

Currently in Philadelphia, oTIS receives the Access database and distributes it to interested City agencies, including PCPC, Streets, and PDPH. PCPC uses this data as part of the Civic Design Review process and in its district plans. PDPH uses it for initiatives like Safe Routes to School. PDPH is also responsible for processing the PennDOT crash data into a geodatabase format maintained by GSG in GeoDB2, the City's shared GIS database.

GeoDB2

GeoDB2 is a comprehensive database and GIS tool that is accessible by all City offices. Data in GeoDB2 may be restricted based on four permission levels: public, enterprise, agency, and individual. Individual and agency permissions limit data access to an individual or a department, respectively. Enterprise makes data available to all departments in the City, and public access indicates that the data should be pushed out to Open Data Philly, the City's open data portal. As of 2016, geocoded PennDOT crash data layers have public access, meaning they are available to the public via Open Data Philly.

PennDOT crash data in GeoDB2 is easily accessible to offices across City government and ensures that agencies are dealing with a consistent dataset.

Since it is fed by PennDOT's Access database, it is also consistent with statewide crash data and includes all reportable crashes in Philadelphia. This data is also quality controlled through a robust state-run process. Since it relies on data from PennDOT, however, there is a significant delay between the time that a crash occurs and when it is available for analysis in GeoDB2. The benefit is a complete dataset for the entire year. See Table 1 for a comparison of the three crash data products used by the City.

TABLE 1 | COMPARISON OF PHILADELPHIA CRASH DATA PRODUCTS

	PTDMS	PennDOT Database	GeoDB2
Data Sources	PPD reportable and non-reportable crash data	All reportable crashes (PPD, State and SEPTA police)	PennDOT database
Platform	GIS	Access database	GIS-based geodatabase
End Users	Streets	Distributed by oTIS to PDPH, Streets, PCPC	Available to all City of Philadelphia agencies
Uses	Streets: Tailor-made, standardized reports on crash trends, Automated Red Light Enforcement prioritization	PDPH: Community Health Assessment	PDPH: Safe Routes to School PCPC: Civic Design Review, District Planning oTIS: Vision Zero
Strengths	Robust, custom-designed, GIS-enabled analysis tools Access to reportable and non-reportable PPD crash data Crash data available on a short timeline	Standard format statewide Includes all reportable crash data, including State and SEPTA police Quality control performed by PennDOT	Data is stored in a central, protected location Shares benefits of PennDOT data GIS-enabled
Limitations	Access limited to Streets Lacks data on injury severity Data must be quality controlled internally	Long delay for access to data No "master" file stored locally	Relies on PennDOT and therefore subject to same delay Requires GIS knowledge to use

Source: DVRPC (2017)

The Future of Crash Data: TraCS

TraCS, which was first implemented for the Pennsylvania State Police in 2008, is in the process of being implemented for PPD.[1] TraCS simplifies the process of reporting crashes and has been shown to result in significantly faster reporting of crash data with significantly fewer errors. The police officer inputs crash reports directly into the electronic system, which transmits the report to a supervisor for approval, and then directly on to PennDOT if it is a reportable crash. The TraCS to Locals (TTL) program started in 2012 and supports the rollout of TraCS to local law enforcement agencies. TTL had supported the implementation of TraCS in 119 municipalities as of November 2016.

[1] Craig E. Polen, "TraCS - Traffic and Criminal Software," Pennsylvania State Police, Harrisburg, PA, https://www.psp.pa.gov/About%20Us/Documents/Tracs.docx

CHAPTER 3

PEER CITY RESEARCH FINDINGS

METHODOLOGY

In collaboration with the Office of Complete Streets and members of the CAT, DVRPC developed a list of interview questions to ask peer city representatives about their data analysis process for Vision Zero (see Appendix A). The questions were organized into three categories: the data sources used, the methodology behind the analysis, and the data management process. These categories were selected to learn about each peer city's approach to identifying priority locations and behaviors for the Vision Zero action plan, as well as the database or other repositories used to maintain and share Vision Zero-related crash data.

The project team reached out to transportation officials at cities across the country, as well as two international locations, and set up interviews (see Table 2). The interview questions were shared with interviewees prior to the interview. Representatives from the National Association of City Transportation Officials (NACTO) sat in on most interviews. Despite the previously shared questionnaire, the project team found that a more effective format was to have the interviewee describe their process in a narrative style and for the project team to ensure that all of the main issues from the questionnaire were addressed in the narration of the city's Vision Zero analysis. This allowed for details to come out that may not have arisen if the interview focused only on the questionnaire.

After each interview, the project team committed their notes into a narrative description of the city's approach to Vision Zero. These narratives were shared with each city interviewed to ensure the description was an accurate portrayal of the city's process. All nine narratives were vetted and edited by the subject city and are included in Appendix B of this report.

TABLE 2 | LIST OF INTERVIEWS

Interview Date	City/Location	Interviewee	Title	Agency
3/6/2017	National	Matthew Roe	Designing Cities Director	National Association of City Transportation Officials
3/10/17	Washington, DC	Jonathan Rogers	Transportation Management Specialist	District Department of Transportation
3/22/17	Los Angeles	Tim Black	Data Analyst	Los Angeles Department of Transportation
3/23/17	Portland	Clay Veka	Vision Zero Project Manager	Portland Bureau of Transportation
		Clinton Chiavarini	Senior GIS Specialist	Metro
3/24/2017	Boston	Charlotte Fleetwood	Senior Transportation Planner	Boston Transportation Department
3/27/17	Seattle	Jim Curtin	Senior Transportation Planner	Seattle Department of Transportation
		Allison Schwartz	External Outreach Advisor	Seattle Department of Transportation
3/29/2017	New York	Rob Viola	Director, Safety Policy & Research	New York City Department of Transportation
4/13/17	San Francisco	Devan Morris	Data Analyst and Cartographer	San Francisco Department of Public Health
		Leilani Schwarz	Epidemiologist	San Francisco Department of Public Health
4/18/17	London	Joe Stordy	Research and Data Analysis Team	Transport for London
		Simon Bradbury	Senior Strategy and Planning Manager	Transport for London
5/4/17	Sweden	Matts-Ake Belin	Project Leader	Swedish Transport Administration

Source: DVRPC (2017)

FINDINGS

This section outlines the main themes from each city's approach to their Vision Zero analysis and data management processes connected to Vision Zero. The high-level descriptions in this section are drawn from the more in-depth narratives found in Appendix B.

New York

The New York City Department of Transportation (NYCDOT) conducted analysis of New York State Department of Transportation (NYSDOT) and New York Police Department (NYPD) crash data and found that pedestrians account for the majority of crash injuries in New York City. This, and their status as vulnerable road users, informed the justification for using pedestrian killed and severe injury crashes (KSI) as the primary metric to identify priority locations. In addition, NYCDOT felt that focusing improvements on locations with high pedestrian KSI would improve safety for all modes, not just pedestrians. In order to select priority locations, NYCDOT identified geographies that represented approximately 50 percent of pedestrian KSI in each borough of the city. The focus on these geographies was adopted to lower the overall pedestrian KSI citywide while also ensuring an equitable geographic distribution of improvements. In addition, the focus on addressing 50 percent of the KSI experience was both statistically defensible and easy to understand, which helped with messaging.

NYCDOT developed both internal and external data viewers to support Vision Zero. Currently, detailed crash data is available for analysis from the state on an annual update cycle with less detailed data from the NYPD on a monthly update cycle. NYCDOT uses its internal Safety Data Viewer to provide Vision Zero-related analysis throughout the departments involved in roadway improvements at a very detailed level (see Chapter 4 for more detail on NYCDOT's Safety Data Viewer). This helps ensure that project managers prioritize projects that address the city's Vision Zero goals. NYCDOT also maintains the Vision Zero View, a public-facing website that visualizes crash data from 2009 to the present and provides links to geocoded crash data, street design data, speed limits, and other Vision Zero-related georeferenced data points.

San Francisco

The data analysis behind the HIN of San Francisco's Vision Zero plan was performed by the San Francisco Department of Public Heath (SFDPH) in collaboration with the San Francisco Municipal Transportation Agency (SFMTA).

SFDPH was already collaborating with SFMTA to lead pedestrian safety-related data analysis efforts for the city's WalkFirst initiative. San Francisco's Vision Zero approach is highly data driven, but still incorporates professional knowledge at key junctures. SFDPH has been very successful in matching San Francisco General Hospital emergency department and trauma center data with police data to get a more complete picture of crash incidence and severity in the city.

SFDPH collaborated with SFMTA and the San Francisco Police Department (SFPD) to develop a Vision Zero Traffic Fatality Protocol, to ensure consistency in the definition of Vision Zero fatalities across city agencies. Vision Zero traffic fatalities are reported and mapped monthly on the Vision Zero SF website.

SFDPH maintains the TransBASESF.org webmap, which pairs Vision Zero-related data like the HIN, Statewide Integrated Traffic Records System (SWITRS), and SFPD crash data with relevant datasets covering factors like the built environment, demographics, and institutions. The webmap is built using open-source products and is available for the public to view (see Chapter 4 for more detail on TransBASESF.org).

Los Angeles

The Los Angeles Department of Transportation (LADOT) identified their most vulnerable users by looking at who was most affected by crashes and found that pedestrians and cyclists are overrepresented among crash victims either killed or severely injured: 15 percent of all collisions but about 50 percent of all crash deaths. This justified elevating pedestrian and bicycle crashes over vehicle-only crashes, but vehicle-only crashes were not removed entirely from the analysis, just weighted less. Similarly, LADOT incorporated feedback from Vision Zero stakeholders that identified severity, vulnerability, and social equity as the most important factors to address in road safety and therefore assigned weights to these priorities as well.

LADOT relies on SWITRS for crash data. SWITRS is provided to LADOT in an Access database, which LADOT uses to populate their RoadSafeGIS software (this recently replaced the Data Viewer software they previously used). In the past, SWITRS only made relatively old (one to two years) crash data available. SWITRS has made strides to produce data within six months of the end of the calendar year. In addition, the Los Angeles Police Department (LAPD) is beginning to pilot electronic reporting, which may be reportable directly to LADOT and also allows them to add fields not currently tracked by SWITRS. LADOT has a Vision Zero page on the city's public-facing GeoHub, which provides detailed information on crash data, analysis, and the HIN.

Portland

The Portland Bureau of Transportation (PBOT) took a modal approach to its Vision Zero analysis, identifying high crash networks for pedestrians, bicycles, and vehicles separately. The networks were then overlaid to arrive at an overall High Crash Network for the city. To ensure that the Vision Zero plan addressed equity issues, PBOT overlaid the High Crash Network with the Communities of Concern equity index and pushed for investments to be made in those areas first. PBOT and the local metropolitan planning organization (MPO), Metro, also explored incorporating a risk analysis and hospital data into their Vision Zero plan, but these efforts had mixed results.

In Oregon, fatal crashes are reported by the police, while more minor events are self-reported by the parties involved to the Driver and Motor Vehicle Services (DMV), which then reports them to the Oregon Department of Transportation (ODOT). There is a significant time delay (one year or more) until ODOT is able to make complete information available, although they do issue updates in the interim. Data received from ODOT is geocoded and mapped in-house by PBOT. PBOT performed data analysis for the Vision Zero plan in GIS. PBOT also published the 2005–2014 crash data used to identify the High Crash Network online using an Esri ArcGIS Online map.

Washington, DC

The District of Columbia Department of Transportation (DDOT) has a unique role as the transportation authority for both the city and “state” (the District of Columbia). Their Vision Zero analysis was an iterative process that considered both crash data and crowdsourced problem location input. Moving forward, DDOT is exploring developing a risk analysis model based on multiple inputs like land use and physical attributes, in addition to crash data and public perception input.

DDOT has developed a robust data management process. The Metropolitan Police Department (MPD) reports crashes directly to DDOT. Since shifting to electronic reporting, DDOT receives crash data every 24 hours from MPD in a raw data format. They have a proprietary software interface called TARAS that produces standardized reports from this raw data. DDOT is responsible for geocoding the data and pushing it onto the DC Open Data Portal. Internally, DDOT uses a version of the open data portal to share data and analysis throughout the department. DDOT has also begun publishing moving and non-moving violations data on the data portal as a result of their Vision Zero initiative.

Seattle

Seattle is lucky to already be a very safe city in terms of traffic-related KSI. It ranks next to Sweden—the birthplace of Vision Zero—in road fatalities per 100,000 people. Seattle's Vision Zero efforts have focused strongly on the physical characteristics of the road. Its initial prioritization scheme started with physical characteristics but ultimately weighted them lightly versus crash incidence. Its more recent Bicycle and Pedestrian Safety Analysis (BPSA) focuses much more on road characteristics as the guiding metric to prioritize investments.

Seattle also has a robust data management process with very rapid access to new crash data. The Seattle Department of Transportation (SDOT) is responsible for collecting, maintaining, and mapping police crash data. Incidents are recorded by the police directly into Hansen, the city's asset and incident management database. Crash data is available approximately two weeks after the event occurs. SDOT pulls standardized queries on crash data from Hansen using Collision Cube, a proprietary interface. This data can then be mapped in GIS for further analysis. SDOT also has access to police citation data through another database used by the police called Sector. Access to this database was gained in the transition to electronic reporting.

Boston

The Boston Transportation Department (BTD) identified two Priority Corridors and two pilot zones for a Slow Streets program in the run-up to publishing their Vision Zero plan. Rather than rely on police crash report data from the state department of transportation (DOT) as its starting point like most other cities interviewed, BTD used data from Boston Emergency Medical Services (EMS) as a proxy for crash injury data, combined with homicide data from the Boston Police Department (BPD). BTD worked closely with EMS and BPD to identify the priority locations.

EMS data is a more consistent and comprehensive dataset than BTD crash data. It has a large number of data points and is updated frequently, making it very reliable and useful. EMS data is automatically transferred to the Department of Innovation Technology (DOIT). While EMS collects data on whether the call resulted in Basic Life Support (BLS), Advanced Life Support (ALS), onsite fatality, or patient refusals, this data is not publicly shareable due to Health Insurance Portability and Accountability Act (HIPAA) constraints.

London

Transport for London (TfL) published Safe Streets for London (SSfL) in June 2013. The plan employs a robust data analysis of vulnerable users. By measuring both the KSI incidence and the KSI risk by mode and other demographic characteristics, TfL is better able to target their investments and goals for reducing KSI in London.

TfL uses the STATS19 dataset, which contains crash data reported by the Metropolitan Police, as well as some self-reported crashes. TfL is currently working with the Metropolitan Police to create a near-live dataset on crashes. In addition, TfL is working to make it easier for people to self-report crashes and now has an online self-reporting option. In the United Kingdom, any crash may be reported—not only those involving vehicles—although non-vehicle crashes are likely severely underreported. SSfL-related analysis is made available to the 33 borough governments in London via an online portal. In addition to maps of KSI incidence and other data points, TfL also provides online dashboards for boroughs to follow their progress on various measures set forth through SSfL.

Sweden

Sweden is the birthplace of Vision Zero; it was instituted nationwide following an act of Parliament in 1997. Now in place for 20 years, Vision Zero has advanced considerably in Sweden. Rather than focus on where fatal and severe injury crashes occur, the Swedish Transport Administration (STA) is now focused entirely on proactively preventing crashes by addressing the remaining parts of the roadway system where they have not upgraded facilities in line with Vision Zero-related design standards. They rely heavily on many years of experience and research dating to the 1960s to install treatments and pursue policies nationwide that are known to lower the kinetic energy present when crashes do occur (i.e., reduce speed and severity).

All police crash data and all health records associated with a crash feed into a single database called the Swedish Traffic Accident Data Acquisition (STRADA), which STA uses to identify and analyze crash problems. Working with hospital data allows STA to identify crashes that were not captured on police reports, often involving pedestrians or bicyclists that only went to the hospital and did not call the police. Also, the severity of each crash is verified by health professionals and does not rely only on what police report on the scene. Every fatal crash is investigated by a crash analysis team that goes to the site of the crash to gather data and learn more about the circumstances. The crash analysis team includes a range of experts, from road engineers to healthcare professionals.

COMMON THEMES

HIN

Vision Zero cities across the country have identified priority locations where they will invest in safety improvements. These locations have a variety of names, such as the High Injury Corridors (HICs) in San Francisco; the High Injury Network in Los Angeles; the High Crash Network in Portland; the High Crash Corridors in Washington, DC; or simply the Priority Corridors in New York City, Boston, and Seattle. The desired result, however, is largely the same, which is to focus on the most dangerous corridors in the city. Many cities looked at intersections in addition to corridors (even priority areas in the case of New York City), but this was consistently considered secondary to the holistic approach of looking at the crash experience along a corridor with similar characteristics.

The most common practice among the Vision Zero cities was to limit the crash data analysis to KSI crashes. This follows best practice supported by the Federal Highway Administration and the National Highway Transportation Safety Administration. This was not true of every city interviewed but applied to most. There was more variation in the types of crashes that were included in the analysis and whether or not certain road users were granted a greater weight in calculating where crash incidence was most severe. Overall, however, most cities incorporated some kind of vulnerable user.

Data Management

Vision Zero cities employed a variety of databases and other software for the analysis of crash data. In addition, access to crash data varied, both in terms of the speed with which it was received by transportation planning officials and who was involved in transferring the data.

The majority of cities interviewed maintained crash data in both an internal platform used by officials to analyze data and prioritize investments and an external data viewer available to the public to view and sometimes manipulate crash data and other data points related to Vision Zero (see Table 3).

A major obstacle for cities implementing Vision Zero is the delay imposed by waiting for crash data to become available from the state DOT. Most cities interviewed started using state DOT data for the original Vision Zero action plan, but many later moved toward receiving data directly from local police. This dramatically reduced the time it took for crash data to become available for analysis from the time of the crash. Cities that rely on state DOT data generally wait one year or more from the time of a crash until the crash data is available to analyze. Cities with direct access to police data are generally able to work with the data within one month, depending on who is responsible for and who has capacity to quality control the data.

TABLE 3 | VISION ZERO DATA PLATFORMS

City*	Internal Data Platform	External Data Platform
Portland	GIS	Esri GIS Online Map
Boston	GIS	Esri GIS Online Map
San Francisco	TransBASESF.org	TransBASESF.org
Seattle	Hansen/Collision Cube	Vision Zero Dashboard & Webmap
Sweden	STRADA	n/a
Washington, DC	TARAS	Open Data Portal
New York	Safety Data Viewer	Vision Zero View
Los Angeles	RoadSafeGIS	GeoHub
Philadelphia	GeoDB2/PTDMS	Open Data Philly

Source: DVRPC (2017)

* The interview with TfL did not address specifics on the data platform they use for implementation of SSfL, so the city is not included in this table.

CHAPTER 4

CRASH ANALYSIS STANDARDS AND RECOMMENDATIONS

The final task for the Philadelphia Crash Analysis Standards and Recommendations project was to make recommendations to the City on how to evolve both crash data management and crash analysis practices to enable data-driven performance measurement to help guide safety investments. This section is divided into three parts. Presented first are recommendations for the development of a Vision Zero-related HIN, which were previously reported to the CAT on May 8, 2017. This work is an expansion of Task 3 from the scope and was added when the project was aligned with the goals of the Vision Zero Evaluation and Data Subcommittee. The second and third sections explore changes Philadelphia can make to evolve its crash safety work and data management to promote data centralization, standardization of analysis methods, and ease of use.

HIN ANALYSIS

The following recommendations deal with the most common practices for identifying a HIN, gleaned from the interviews conducted with seven U.S. cities, London, and Sweden and outlined in the previous chapter. The five key trends in HIN analysis are outlined in Table 4. The recommendations focus on parameters for a HIN that require a minimal to moderate investment of time. This limitation was incorporated because Philadelphia established an aggressive timeline to produce its Vision Zero action plan, a situation similar to what many of the cities interviewed faced when they initially adopted Vision Zero. The recommendations for the HIN analysis, therefore, focus on how peer cities produced their first HIN, even though some cities have more recently revisited their approach to consider creating a new network based on a complex, risk-based analysis (discussed in detail under "The Risk Model Approach").

TABLE 4 | TOP TRENDS IN HIN ANALYSIS

HIN consists of corridors and intersections
Use KSI/mile metric
Analyze five years of state DOT crash data
Focus on pedestrians and cyclists
Compare to existing equity index

Source: DVRPC (2017)

Geographic Analysis

Every city interviewed identified high injury corridors. Intersections were included in most plans. Only one city incorporated high injury areas (New York).

	Description	Peer Cities
Corridors	Analysis along road segments	All
Intersections	Analysis at intersections within a custom buffered area	New York; San Francisco; Los Angeles; Portland; Boston
Areas	Analysis across areas of the city	New York

Primary Metric

A focus on KSI crashes was the prevailing practice in Vision Zero-related data analysis. The cities interviewed applied KSI in different ways. The most common approach was to normalize KSI crashes by road segment length and use these values to identify high injury corridors (New York; San Francisco; London). Other cities used kernel density maps (Washington, DC; Los Angeles) or absolute number of KSI crashes along a corridor (Portland; Boston) to identify the top corridors. Intersection analyses varied; in some cases it involved identifying locations with the greatest number of KSI crashes within a buffer (New York; London), although a standard buffer size was not common, nor was a threshold of crash experience for identifying priority intersections.

	Description	Peer Cities
KSI	Top corridors chosen by greatest number of KSI crashes	Portland; Boston
KSI/mile	Top corridors chosen by greatest KSI/mile	New York; San Francisco; London
KSI density	Top corridors chosen by analyzing a kernel density map of KSI across the city	Los Angeles; Washington, DC

Crash Data Source

All cities interviewed used state crash data for their initial plan, except for two that relied on local data sources (Boston; Seattle). Using five years of crash data was common practice among five cities (New York; Washington, DC; Los Angeles; Seattle; San Francisco). Many cities later evolved their crash data management process to receive data directly from police (typically connected to electronic reporting) or from trauma centers (New York; Washington, DC; Seattle; San Francisco; London).

	Description	Peer Cities
State DOT Data (Five Years)	Most common data source for crash data for developing the initial Vision Zero action plan	New York; San Francisco; Los Angeles; Washington, DC
Local Police Data	Many cities evolved their crash analysis to use police data directly; this typically began after the initial action plan was released	Boston; Seattle; New York; Washington, DC; San Francisco; London
Trauma Center Data	Fewer cities were able to successfully incorporate trauma center data	San Francisco

Vulnerable Users

Some cities prioritized certain road users or locations by either introducing weights into a formula-based approach (Los Angeles; Seattle) or limiting the data included in the analysis to emphasize a priority user (Portland; New York; Washington, DC). A plurality of cities used one of these methods to prioritize pedestrians and cyclists (Washington, DC; Portland; Los Angeles).

	Description	Peer Cities
Bicyclists and Pedestrians	Some cities weighted crashes involving pedestrians and/or bicyclists more heavily	New York; Portland; Los Angeles; Washington, DC
Older Adults and Children	Some cities focused on areas with larger numbers of older adults or children	Boston; Los Angeles

Equity

Most cities incorporate an equity "lens" into their Vision Zero plan, in order to measure how underserved areas of the city are affected by crashes and help prioritize investments in those areas. Three cities (Portland; Los Angeles; San Francisco) used an existing equity index to identify how many miles of the HIN were located in these areas and stated that they would prioritize investments there.

	Description	Peer Cities
Equity Index	A preexisting equity index was used to compare neighborhoods across the city to the HIN	San Francisco; Portland; Los Angeles
Equity Reporting Requirement	City departments are required to report on how policies further citywide equity goals	Seattle; London

The Risk Model Approach

Several of the cities interviewed indicated an interest in developing a risk model to proactively predict where crashes are likely to occur, rather than reactively rely on crash data to identify priority locations. Of these cities, two had made substantial strides toward creating such a model. New York City created a risk model for the initial Vision Zero plan but changed course and decided to use a simple metric (pedestrian KSI/mile) instead. They are now working with DataKind, a non-profit that provides pro bono technology services, to create a new risk model. Seattle worked with Toole Design Group to complete a bicycle and pedestrian risk model and has incorporated it into their Vision Zero prioritization system. Sweden, which has an advanced Vision Zero program, does not use a predictive risk model but does prioritize based on cross-section data rather than crash incidence because they know what types of roads lead to crashes and have greatly reduced their inventory of dangerous roads over the last 20 years.

Developing a risk model is a significant investment. It requires a robust collection of data points and expertise in developing statistical models. Seattle is the only city interviewed to successfully complete this project; their effort was funded by the $930 million Levy to Move Seattle, which injected substantial new funds into the city's transportation budget.[2] New York City's effort, on the other hand, shows that it may be possible to find more cost-effective ways of developing such a model. Barring a large increase in transportation funds, like what SDOT experienced, Philadelphia is more likely to succeed in developing a risk model by looking for non-profit partners like DataKind to develop a risk model.

[2] Elliot Helmbrecht, "The Transportation Levy to Move Seattle," Seattle Department of Transportation, accessed August 16, 2017, http://www.seattle.gov/transportation/levytomoveseattle.htm.

CRASH DATA MANAGEMENT AND ANALYSIS

The following recommendations relate to ways that Philadelphia can evolve its crash data management system to better gather, share, and analyze crash data. The recommendations are split into crash data analysis standards and data management strategies and, like the HIN recommendations, are inspired by trends found in the practices of the interviewed city and country representatives, designed to build on Philadelphia's strengths. These recommendations were presented in draft form to the CAT on July 31, 2017, and generally endorsed with some modifications.

Broadly, these recommendations advance the recommended goals of **centralized crash data management**, **standardized crash analysis practices**, and **ease of use**.

Centralized Crash Data Management

Standardized Crash Analysis

Ease of Use

Data Analysis Standards

Tracking performance through various performance measures was included in the Fixing America's Surface Transportation Act federal transportation legislation of December 2015. To the best of our understanding, the City currently does not formally track safety performance, neither in terms of crash trends by location nor regarding outcome of investments. Implementing Vision Zero provides the opportunity to track the performance of both.

As previously discussed, this study recommends performance metrics for consideration in identifying a HIN for the City based on KSI crashes. This recommendation, among others, was culled from the research and interviews conducted with Vision Zero peer cities from the United States and abroad, working with the Evaluation and Data Subcommittee to Philadelphia's Vision Zero effort.

Adopt HIN as System Performance Baseline

Once the data-driven Vision Zero HIN has been established, this citywide network of priority locations will serve as a baseline for tracking safety performance over time. When conducting any planning or engineering work that includes a crash analysis, the Vision Zero HIN should be cross-checked to see if any portion of the HIN coincides with the project or study at hand. Having the HIN layer available in GeoDB2 allows users to make these comparisons easily.

Develop Priority Lists for Network Screening

In addition to Vision Zero HIN tracking, a reimagined PTDMS (see the following section: "Data Management Strategies: Short-Term Recommendations") presents a good opportunity to conduct other network screening analyses that can be used to prioritize investments: e.g., intersection priority lists and other contributing factor-specific lists like nighttime crashes or bicyclist crashes. The specific metrics for continual tracking would be informed by historical crash trends. Just like the Vision Zero HIN map layers, layers for these priority lists can be used in planning and engineering work as a reference when establishing a baseline crash analysis. Comparison to existing priorities informs new efforts and may yield cost savings while promoting consistency and transparency.

Consider Other PennDOT Datasets

PennDOT District 6-0 maintains a webmap of safety data and projects, some of which are available to the public, while some are restricted to partners. Even though the City does not maintain state roadways, knowledge of state priorities within the City can help inform City planning efforts and promote collaboration between Philadelphia and PennDOT. Where possible, these data layers should also be incorporated into GeoDB2.

PennDOT is moving toward a predictive analysis-based network screening method that will replace their previous product, the high crash location (HCL) lists, which was based on historical crash trends only. PennDOT's forthcoming new approach, based on the Highway Safety Manual, considers roadway cross-section types and various roadway characteristics that reflect the state's system, making it locally calibrated, which is intended to improve accuracy. The predictive method is used to estimate the expected average crash frequency of an individual site and provides data on the entire network, not just problem locations. This approach may be a useful consideration as Philadelphia's analysis methods evolve over time.

Data Management Strategies: Short-Term Recommendations

The City currently uses two systems to do similar work. As discussed in Chapter 2, Streets uses PTDMS to analyze current-year crash data for both reportable and non-reportable crashes, as well as complete-year historical data (reportable and non-reportable).

INCT data is received directly from the PPD as it occurs, although subject to a time lag. This data is manually integrated into PTDMS, which is the crash data's first destination. The other City agencies that use crash data do not have permission to use PTMDS, so they work with complete-year historical data received from PennDOT by oTIS, which manually distributes copies of the database in Access format to PCPC and PDPH—the second crash data destination. PDPH shares this same data with GSG, who then includes it in GeoDB2 where City agencies can use it for GIS analysis. GeoDB2 and Open Data Philly are the third crash data destinations. These processes are depicted in Figure 1. Centralizing datasets and eliminating duplicative processes will promote consistency and create new opportunities for better data management.

Figure 3 depicts an evolution of Philadelphia's current practices. The following narrative describes the proposed changes.

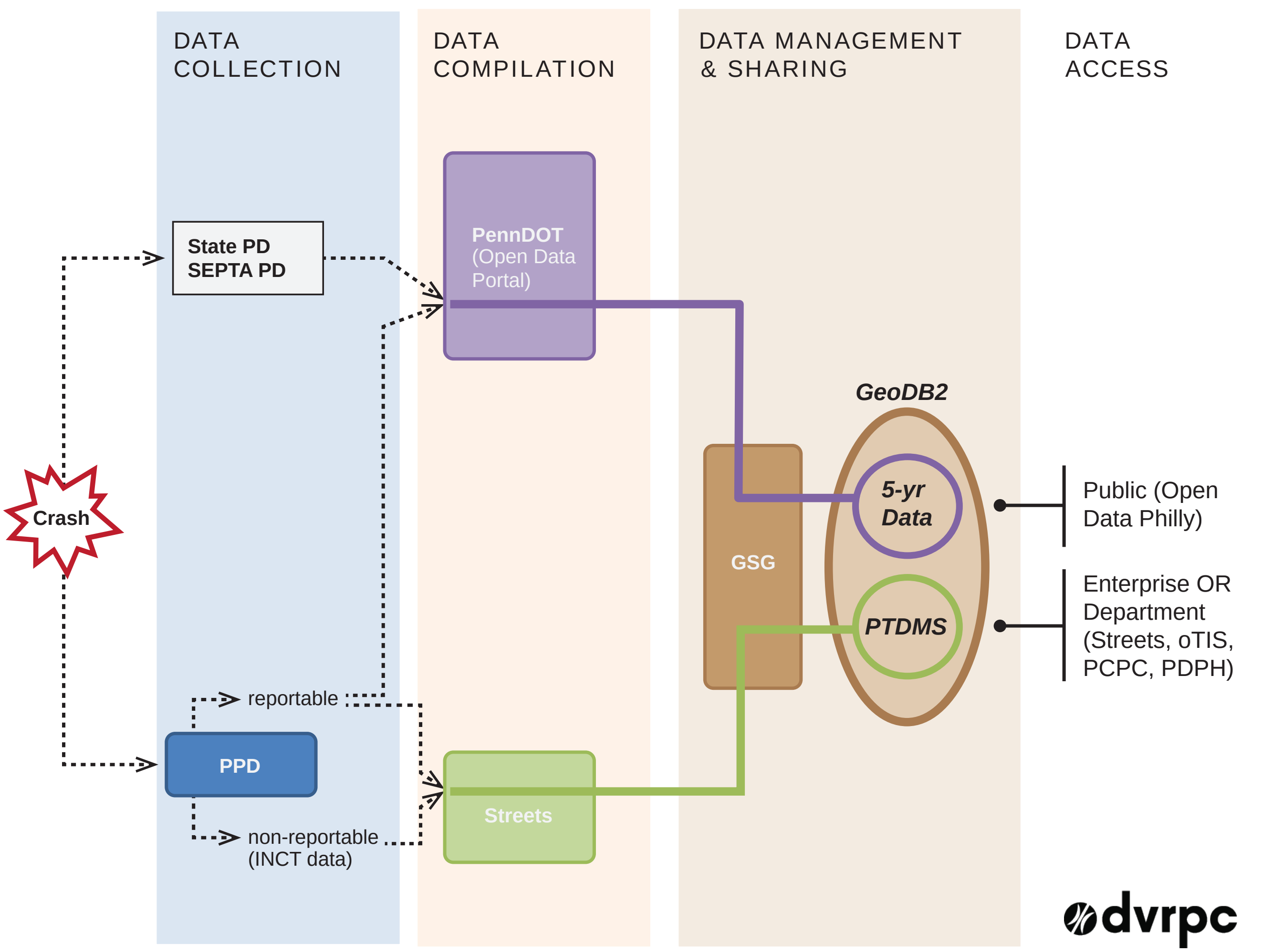
Centralize Data Storage and Management

Store all years of reportable and non-reportable crashes in one enterprise database. Analysis tools like Excel, Access, R, and GIS can draw data from a single data repository, making duplicate copies of the crash database unnecessary. GeoDB2 is currently performing this function for various datasets and serves as the City's primary enterprise database. GeoDB2 already includes the historical reportable crash data received from PennDOT. To include current-year reportable and non-reportable data (currently only in PTDMS), in addition to historical data, would make this data available to all crash data users among City agencies for use with GIS and other data tools. With all crash data residing in GeoDB2, it would ensure that all users are accessing the same data, and the most current data. As with the other datasets in GeoDB2, the crash data would be managed by GSG.

Incorporate PTDMS into GeoDB2

Moving PTDMS into GeoDB2 will help streamline Philadelphia's processes. PTDMS is essentially an ArcGIS add-on designed to perform customized queries and produce reports. City representatives agreed that PTDMS could reasonably be incorporated into GeoDB2. There are advantages to this evolution. First, PTDMS—currently available only to Streets—could be made available to other City agencies and could be set with permission levels to ensure security, if needed. Also, PTDMS within GeoDB2 would provide the opportunity to use other datasets in conjunction with crash data for more robust analyses. Unexplored are the barriers to migrating this tool, including cost, institutional barriers, technical feasibility, etc. Since this tool is under an active contract, it is practical to explore options for evolving it before considering a replacement tool.

FIGURE 3 | PROPOSED PHILADELPHIA CRASH DATA FLOW CHART



Source: DVRPC (2017)

Evolve Data Compilation, Sharing, and Access

In the scenario proposed in Figure 3, PennDOT Central Office and Streets will continue to be the recipients of the data from PPD. What changes is that following the location accuracy check performed by Streets, the data is then handed over to GSG for integration into GeoDB2. PennDOT data can be downloaded directly from their open portal (http://data-pennshare.opendata.arcgis.com/) by GSG, rather than through special request by oTIS. GSG can geocode the PennDOT data and upload a new five-year dataset, which should be the standard dataset for crash-related analysis citywide. Once updated in GeoDB2, users from City agencies can access the data from GeoDB2 for use in GIS, database software, or PTDMS, without having to maintain local copies of the data.

Complicated geoprocessing within GeoDB2 has a negative effect on GeoDB2 system performance for all users. If a user needs to perform such functions, they would have the ability to export the raw data they need from GeoDB2 and store it locally for faster performance. Although not ideal, this may be a practical necessity given hardware and software limitations. The benefit is that GeoDB2 will be the only source for the data.

Data Management Strategies: Long-Term Recommendations

Philadelphia has opportunities to evolve existing crash data management practices in the medium- to long-term future that can further achieve the goals of centralization, standardization, and ease of use. The recommendations identified here follow the same general strategy of drawing on trends discovered through the interviews with Vision Zero transportation officials.

Align PTDMS with Vision Zero

PTDMS can be evolved to align with Vision Zero goals and streamline data analysis and reporting requirements. Vision Zero implementation benefited from existing, custom-built software platforms in a number of the cities interviewed. PTDMS in its current form is of some use to Vision Zero analysis but is limited especially by the lack of injury severity data. A recommended first step is for Philadelphia to work with the consultant that maintains PTDMS to add injury severity to the tool's queries. Further changes should include incorporation of the Vision Zero HIN and new Vision Zero-specific reports to streamline processes, like producing data for the Vision Zero dashboard and easy tracking of crash trends over time.

Align TraCS Implementation with Vision Zero

A central benefit of migrating PTDMS and its underlying data into GeoDB2 is opening access to police data to more departments within the City, especially those involved in Vision Zero analysis. Gaining direct access to police records, rather than relying on the state DOT, was a common goal or practice among most of the cities interviewed. This substantially reduces the lag time to gain crash data and enables more nimble responses to changing traffic safety issues as they arise. The implementation of TraCS offers a strategic opportunity for the City to ensure that police reporting is aligned with Vision Zero priorities and that crash data is rapidly transferred to GeoDB2 for analysis.

Link Trauma Center Data

Linking police records with trauma center data allows for a more complete picture of the crash incidence around the city, but linking records has proven difficult for most cities. San Francisco was aided by having only a single Level One Trauma Center in the city. In Sweden, a single repository is used for all police and trauma center data related to crashes. Portland gained access to trauma center data but found significant barriers to identifying a common field with which to link trauma center and crash data, which limited its use for Vision Zero-related analysis. In Philadelphia, crucial potential partners like the Jefferson University Trauma Center have expressed interest in working with the City to tackle linking crash and trauma center data. Unfortunately, unlike San Francisco, Jefferson does not capture all of the victims of traffic violence in the city, which means that any effort to link data will necessarily only reflect a segment of the total crash experience and will likely be localized. Nonetheless, a pilot effort among City representatives, PPD, and Jefferson to explore these datasets and identify commonalities is recommended with a long-term goal of pursuing a single repository for all trauma center cases tied to crashes.

Develop an Integrated Safety Management System

Philadelphia should develop an integrated safety management system. An integrated safety management system is a database enterprise that streamlines crash data analysis through an easy-to-use interface and promotes consistency and data purity across City departments. There are several key improvements that a system like this could offer over GeoDB2 and PTDMS:

- **Centralized Data Analysis:** The integrated safety management system should allow multiple users to view and analyze data without creating local copies. In the near-term recommendations, we suggest centralizing data in GeoDB2, but this still leaves some limitations in terms of processing power. Philadelphia should consider database products that will enable users to perform complex analysis on centrally stored crash data and thereby avoid the proliferation of local copies that are susceptible to data corruption and inconsistencies.
- **Web-Based User Interface:** A web-based interface promotes transparency and ease of use, since it does not require a specialized database or GIS knowledge and makes sharing data with the public simple. If the data management system is made into a public-facing product, a web-based interface would enable it to dovetail with Vision Zero public engagement priorities and increase the value of the Vision Zero website (if it is housed there) both internally and to the public.
- **Open Database Connectivity:** Incorporating open database connectivity allows underlying data tables in the centralized database system to be accessed and analyzed by many different programs. GeoDB2 has some of these capabilities already, but it is not clear to what extent it is currently possible to access data in GeoDB2 with programs like R or Access without downloading a local copy. A relational geodatabase like TransBASESF.org (see "TransBASESF.org: An Integrated Health and Transportation Data Management System" for more detail) has the capacity for programs, including Esri, Access and R, to draw on and perform analysis on the underlying data tables. This is a powerful function that allows different departments across the City to continue to perform analyses as they have been but ensures that they draw the information from a centralized database. Philadelphia should continue to pursue greater open database connectivity capabilities wherever possible.
- **Standardized Crash Summary Reports:** Currently, PTDMS offers a range of crash summary reports. An integrated safety management system would allow establishment of a hierarchy of preferred reports to promote consistency across City agencies while still maintaining functionality for specific queries when necessary. Such reports would include agreed-upon data elements summarized consistently to promote efficiency and clear messaging. PennDOT's standard Crash Data Access and Retrieval Tool (CDART) report is an example of a useful format (see Appendix C) that includes chronology information, collision type, crash severity

level (events) and severity counts (people), driver actions, vehicle types, weather, illumination, etc. More examples of recommended features are discussed in the next section.

- **Automated Data Uploads:** Requiring manual uploads of data invites inconsistency around when new data becomes available and increases the potential for error. Wherever possible, automated data upload tools should be used.

Detailed descriptions of the integrated safety management systems used by NYCDOT and SFDPH are presented below.

INTEGRATED SAFETY MANAGEMENT SYSTEMS

New York City and San Francisco both offer examples of robust integrated safety management systems. They share many features, including a web-based interface, centralized data storage and analysis, and citywide access permissions. Both systems were developed in-house. San Francisco's TransBASESF.org platform is available to the public, but New York City's Safety Data Viewer is limited to users within New York City government. Another key difference is that the Safety Data Viewer is used primarily for standardized reports that promote consistency in data analysis, while TransBASESF.org is less prescriptive in the analysis performed on its underlying data.

Safety Data Viewer: NYCDOT's Safety Project Management System

The Safety Data Viewer is an internal tool developed by NYCDOT to inform safety-related projects. The tool was developed in-house, without assistance from consultants. Access to the tool is limited to anyone in New York City government, but it is primarily used by project managers and the press office to find the crash history of locations. The Safety Data Viewer allows users to easily view and share safety-related data. The canned reports that the application produces are consistent for each individual user regardless of project, both in the data that they draw from and the fields they populate. The Safety Data Viewer uses a map interface that allows users to select geographies, create new projects (rarely done in practice), and review safety data.

The Safety Data Viewer incorporates several key features which Philadelphia should consider including in a similar tool. It allows the user to select a corridor, intersection, or area, and run a standardized crash summary with key data points, like KSI/mile. In addition, the Safety Data Viewer can produce more detailed reports and provides before/after analysis.

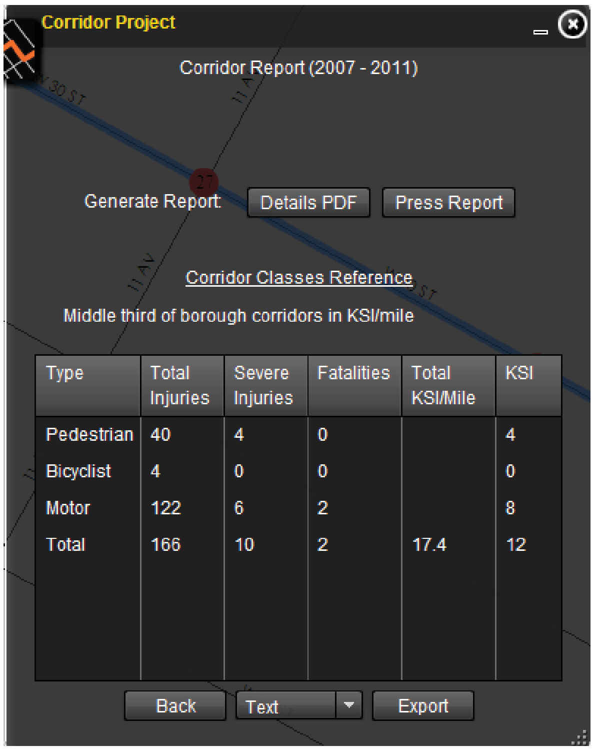
At the corridor level, a user may select segments by drawing a rectangle around the analysis area on the map interface. This populates a new window with the names of the selected segments and allows the user to edit their selection to reflect the project's specific analysis limits. Saving this corridor selection as a "project" will add it to the project database. For each project, Safety Data Viewer will produce a predefined, short report identifying total injuries, severe injuries, fatalities, KSI, and total KSI/mile (see Figure 4). The standardized report also identifies where the corridor falls in the corridor ranking by KSI/mile for the borough, which helps to determine if the corridor is part of the Vision Zero priority network. If a more detailed report is needed, options are available for a "Details PDF" or a "Press Report." All of these reports help to ensure consistency across NYCDOT projects.

In addition to corridor-level projects, Safety Data Viewer users may perform analysis at the intersection level. As with corridor projects, a selected intersection may be saved as a new project to the database and canned reports are produced for the geography. Safety Data Viewer has several other features, including a before/after analysis of crash experience for use as an indicator of project benefit. The advanced query feature allows users to generate a crash list by selecting an area (rather than corridor or intersection) and filtering the results by year, injury severity, and mode (pedestrian, bicycle, and motor vehicle) (see Figure 5).

The Safety Data Viewer is a web-based tool that uses Adobe Flash for the user interface, MS SQL Server for the backend database, and C# ASP.NET as the middle tier. It was built internally, primarily by part-time interns. The tool was initially designed using ArcGIS Adobe Flex API as the map interface, but this product is no longer supported, so NYCDOT is planning to migrate to the new ArcGIS JavaScript API or OpenLayers. While users are able to write to the MS SQL Server, this is rarely done in practice. Crash summary and before/after analysis reports are generally downloaded locally as PDF, Excel, or .csv files.

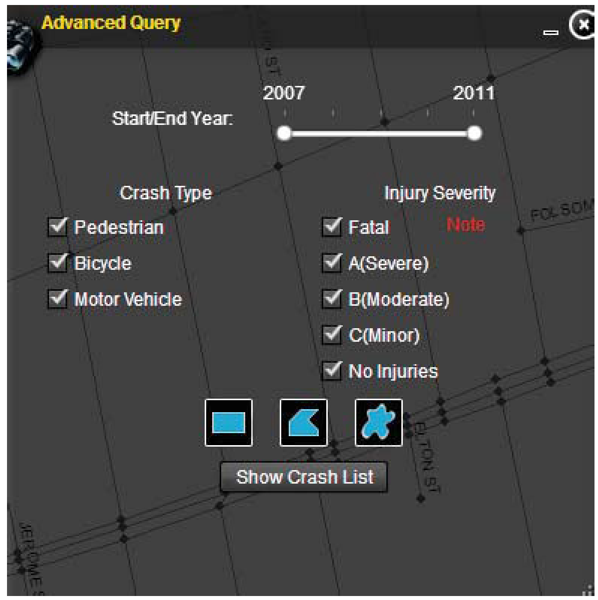
Data maintenance was designed around existing NYCDOT processes, minimizing additional work to support the application. Three unique crash data sources populate the Safety Data Viewer back-end database. The primary dataset is NYSDOT data, which requires a manual annual update. NYSDOT data populates the corridor and intersection crash summary reports. The Safety Data Viewer is also updated on a weekly basis with fatality data that NYCDOT maintains jointly with NYPD and on a daily basis with NYPD data that is very limited in detail. The limited NYPD data is used exclusively for the before/after analysis tool. Both of the NYPD-related datasets are updated automatically and added to Safety Data Viewer using import tools.

FIGURE 4 | CORRIDOR SUMMARY



Source: NYCDOT (2017)

FIGURE 5 | QUERY TOOL



Source: NYCDOT (2017)

TransBASESF.org: An Integrated Health and Transportation Data Management System

San Francisco provides an example of an integrated health and transportation data management system that could fully replace Philadelphia's current system or, alternatively, inspire new ways to innovate Philadelphia's crash management system in the future.[3] TransBASESF.org was developed by the SFDPH to assist with analysis and guide investments related to the intersection of health and transportation. Like Safety Data Viewer, the tool was developed in-house, without consultants. The platform has three primary advantages for San Francisco's Vision Zero effort and similar transportation initiatives:

- a centralized source of crash data and other data sources relevant to Vision Zero analysis housed within a relational database system with geospatial capabilities;
- a web-based interface (see Figure 6) that allows users from within the city and the public to interact with data layers and produce standardized

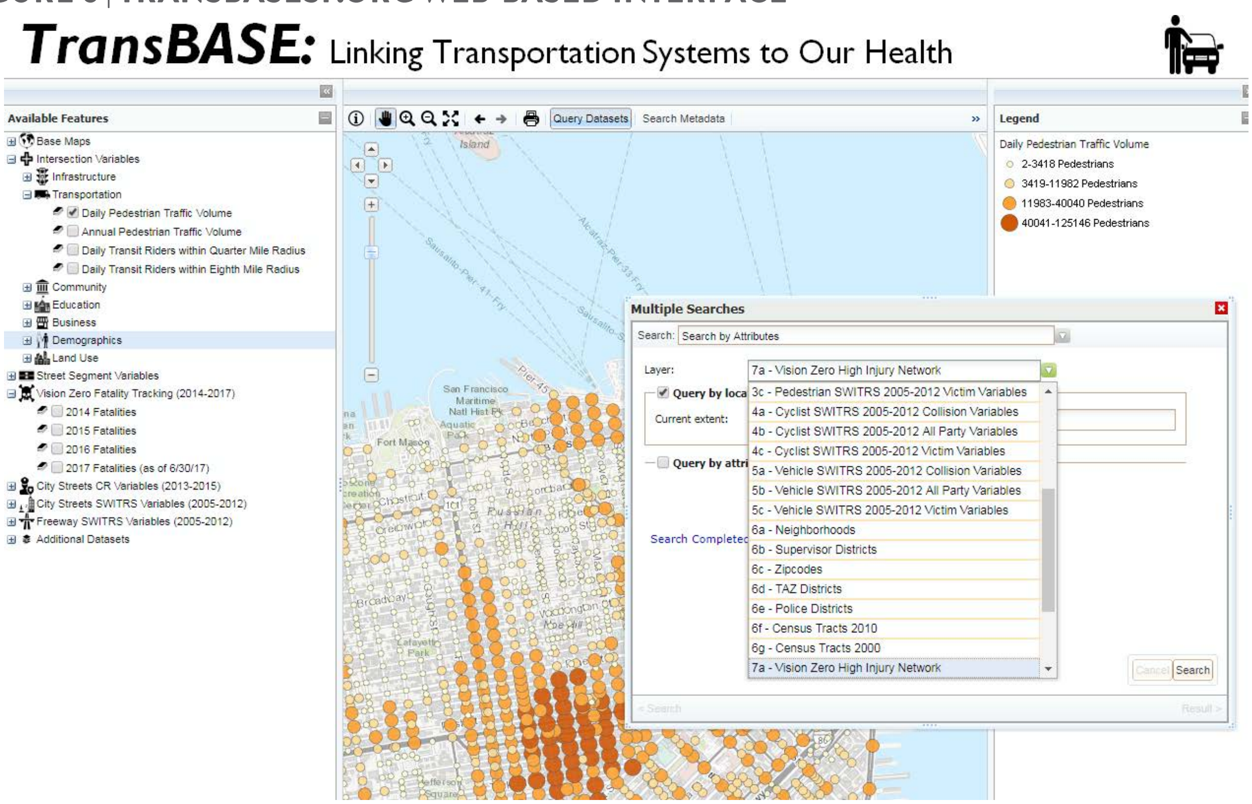
[3] Devan Morris and Megan Wier, "Geospatially Enabled Database for Analyzing Traffic Injuries in San Francisco, California," *Transportation Research Record: Journal of the Transportation Research Board,* no. 2595 (2016): 40–49, doi:10.3141/2595-05.

reports; and

- Open database connectivity that enables a variety of commonly used platforms to access TransBASESF.org's underlying data tables, including GIS-based systems like Esri and spreadsheet-based systems like Access.

As a geospatially enabled relational database system, TransBASESF.org has significant advantages over standalone geodatabases. Data remains stored in a central location, while the interface allows multiple users across a network to create relationships between data tables and query the data using SQL language (see Figure 7 for a screenshot of the back-end interface). Amazon's Elastic Compute Cloud originally hosted TransBASESF.org, which required a monthly fee of approximately $100. This enabled the system to handle spikes in traffic and computational demand. More recently, the database enterprise was migrated into the City of San Francisco's virtual machine, a cloud-based environment

FIGURE 6 | TRANSBASESF.ORG WEB-BASED INTERFACE

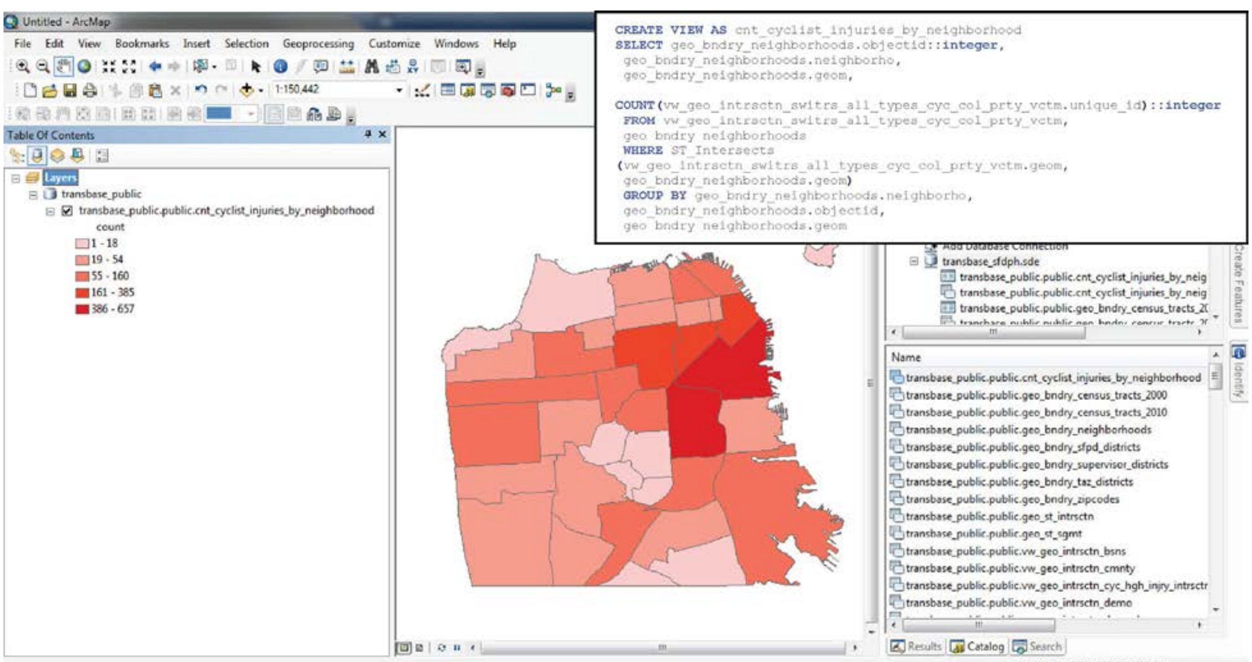


Source: TransBASESF.org (2017)

maintained by the city's IT department. As of 2016, SFDPH was working to automate many of the regular, manual updates needed to keep the data in TransBASESF.org up to date.

SFDPH built TransBASESF.org using open-source software and code and has made the system available to other municipalities for free on GitHub. In order to use TransBASESF.org, Philadelphia would need geospatial data layers for every street segment and intersection, each with a unique identifier. With this data, all other data tables can be related using standard GIS functions.

FIGURE 7 | TRANSBASESF.ORG BACK-END INTERFACE



Source: Morris and Wier, "Geospatially Enabled Database"

APPENDIX A: PEER CITY INTERVIEW QUESTIONS

Philadelphia Vision Zero: Crash Analysis Team

Peer Cities Interview Questions

Participants:

Data Sources

1. What key data was used in the VZ analysis? Please include the data type, format, and update frequency; e.g.: police crash reports/Access database/yearly refresh.
2. How many years of data are used?
3. Are multiple data types joined/combined as part of the analysis?

Analysis Methodology

1. Were your VZ priority focus areas the result of a data-driven process?
2. Did the priority focus areas include citywide determinants of high crash incidence (such as behavioral factors or collision types) as well as geographic areas of high crash concentrations (like neighborhoods or corridors)?
3. Does your process include a regression analysis, or other modeling approach which includes several data types and multiple variables?
4. Is a weighted severity ranking used? If so, please describe it.
5. Does the methodology consider total numbers or rates (by volume, population, mileage)?
6. Describe the analysis methodology performed. For example, do you use a proprietary analysis tool, Access database queries, paper police reports, GIS, or a combination?
7. What metrics are used to determine a priority location? For example, do you use an intersection ranking system that prioritizes places where the crash experience exceeds a city-wide average, or a corridor ranking based on killed and severe injuries per mile?
8. In identifying road segments for a priority corridor network, how are segment lengths determined, e.g.: change in functional class, lack of crash density?

Data Management/Routine

1. What is the update cycle for VZ priority focus areas, corridors, etc.?
2. Is there a central repository for data that all departments involved in VZ analysis and decision making have access to? Is it web-based?
3. Which agency performs the analysis to determine the VZ priority network or high crash locations list? Which agency maintains the data?

Philadelphia Vision Zero DVRPC Page 1

APPENDIX B: PEER CITY INTERVIEW SUMMARIES

NEW YORK CITY

Introduction

Contact:	Rob Viola, Director, Safety Policy & Research, NYCDOT Matthew Roe, Designing Cities Director, NACTO
Interview Date:	3/6/17 (Matt), 3/29/17 (Rob)
Publication:	Vision Zero Action Plan (2014)

Primary Metric

- pedestrian KSI/mile.

Primary Metric Data Sources

- NYSDOT KSI crash data (2009–2013)
- NYPD fatality data (2011–2013)

Additional Data Collected

- crowdsourced problem location data (collected after action plan developed);
- traffic volume data; and
- cross-section and functional class data.

Common Data Not Used

- trauma center and hospital data; and
- equity/demographic data (e.g., an environmental justice index).

NYCDOT conducted an analysis of NYSDOT and NYPD crash data and found that pedestrians account for the majority of crash injuries in New York City. This, and their status as vulnerable road users, informed the justification for using pedestrian KSI as the primary metric to identify priority locations. In addition, NYCDOT felt that focusing improvements on locations with high pedestrian KSI would improve safety for all modes, not just pedestrians. In order to select priority locations, NYCDOT identified geographies that represented approximately 50 percent of pedestrian KSI in each borough of the city. The focus on these geographies was adopted to lower the overall pedestrian KSI citywide while also ensuring an equitable geographic distribution of improvements. In addition, the focus on addressing 50 percent of the KSI experience was both statistically defensible and easy to understand, which helped with messaging.

Methodology

Geographic

Priority locations were identified at the level of the intersection, corridor, and area. NYCDOT identified Priority Corridors using pedestrian KSI/mile as the guiding metric. Corridors were examined in their entirety, and limits were determined by logical break-points like change in functional class or prevailing cross-section but not by the density of crashes. The approach can be described as a combination of data analysis refined by professional judgment and local knowledge. Selection of the corridors was done through an iterative process that started with five years of crash data stored in an Access database. This data was mapped in GIS and the crash data joined to the corridors. Corridors in each borough were then sorted by KSI/mile and the top corridors selected until 50 percent of pedestrian KSI crashes in the borough were contained within the selected corridors. In the case of Brooklyn, these corridors accounted for 9 percent of the total street mileage in the borough. Other boroughs experienced a similar ratio of Priority Corridors to total street mileage.

NYCDOT pursued a similar strategy to identify priority intersections and areas. In the case of intersections, prioritization was based on total pedestrian KSI (i.e., no normalization was used). Rather than capture 50 percent of pedestrian KSI as with corridors, top intersections were selected until they accounted for 15 percent of total pedestrian KSI in the borough. A 15 percent threshold was used to make the number of priority intersections manageable. In Brooklyn, this was 91 intersections, or 1 percent of all intersections. To define intersections, NYCDOT performed a spatial analysis using a buffer large enough to incorporate multileg intersections.

Priority areas were identified by generating a heat map of pedestrian KSI per square mile. Using the same additive process, the worst areas were assigned priority status until 50 percent of pedestrian KSI in the borough fell under the prioritized areas. These areas cover 25 percent of the borough in the case of Brooklyn.

Behavior

Analysis of priority behaviors, like priority geographies, focused on pedestrians. By looking at the NYPD crash data on pedestrian fatalities, NYCDOT identified that arterial streets represent the greatest challenge to pedestrian safety, in part due to higher speeds. NYCDOT also used crash data to determine if there was a higher incidence of fatal pedestrian crashes at certain times of day and among certain groups of people, like seniors and the elderly. To better understand how to target educational campaigns and enforcement, NYCDOT organized pedestrian fatalities into dangerous driver choices, dangerous pedestrian choices, or both. They also provided analysis of hit-and-runs that supported new legislation to even the penalty for a hit-and-run with the penalty for hitting a pedestrian while intoxicated.

Data Management

NYCDOT developed both internal and external data viewers to support Vision Zero. Currently, detailed crash data is available for analysis from the state on an annual update cycle and less detailed data from the NYPD on a monthly update cycle. NYCDOT uses its internal Safety Data Viewer to provide Vision Zero-related analysis throughout the departments involved in roadway improvements at a very detailed level. This helps ensure that project managers prioritize projects that address the city's Vision Zero goals. NYCDOT also maintains the Vision Zero View, a public facing website that visualizes crash data from 2009 to the present, as well as providing links to geocoded crash data, street design data, speed limits, and other Vision Zero-related georeferenced data points.

Like many other Vision Zero cities, New York is interested in incorporating hospital/trauma center data into their analysis. NYCDOT was unable to gain access to this data, but the New York City Department of Health did an independent analysis comparing crash data from NYPD and comparing it to hospital data. They found a significant disparity in the severity recorded by NYPD versus hospital records. NYCDOT is working with Bellevue Hospital on a study of bicyclists and pedestrians hurt while on the system but where an automobile was not involved. The example given was when a bicyclist swerves to miss a driver and as a result crashes his bike and is injured. There was no discussion of how this data might be used.

Supporting Information

Prior to settling on KSI/mile, NYC worked with a consultant on a multivariate regression analysis that considered a range of inputs, such as land use, traffic volume, and street geometry, to predict where crashes would be likely to occur. This reportedly expensive process produced results similar to the KSI/mile approach but was not embraced because its complexity was considered excessive and difficult to explain to policy makers and the public.

Since the adoption of its Vision Zero plan, NYC has started revisiting the modeling approach in a project with DataKind. As described on their website, DataKind "brings together top data scientists with leading social change organizations to collaborate on cutting-edge analytics and advanced algorithms to maximize social impact." DataKind is helping NYCDOT design tools for traffic volume estimation and for traffic crash estimation, with mixed results to date (volume estimation seems good, but crash estimation is difficult to use). DataKind also intended to build a model to test the impact of safety treatments on crash incidence but lacked sufficient cases to build a statistically significant model. DataKind's services are free of charge.

SAN FRANCISCO

Introduction

Contact:	Devan Morris, Data Analyst and Cartographer, SFDPH Leilani Schwarcz, Epidemiologist, SFDPH
Interview Date:	4/13/17
Publication:	Vision Zero San Francisco (February 2015)

Primary Metric

- all KSI/mile.

Primary Metric Data Sources

- SFPD crash data;
- hospital data;
- Zuckerberg San Francisco General Hospital (ZSFG) Level I Trauma center data;
- ZSFG Emergency Department data;
- Office of the Medical Examiner data; and
- EMS data (various ambulance providers).

Additional Data Sources

- Metropolitan Transportation Commission's (MTC) Communities of Concern index (an environmental justice index); and
- crowdsourced problem location data.

Common Data Not Used

- SWITRS (statewide) crash data (used in initial analysis, but no longer).

The data analysis behind the HIN of San Francisco's Vision Zero plan was performed by SFDPH in collaboration with SFMTA; SFDPH was already collaborating with SFMTA to lead pedestrian safety-related data analysis efforts for the city's WalkFirst initiative. San Francisco's Vision Zero approach is highly data-driven, but still incorporates professional knowledge at key junctures. SFDPH has been very successful in matching San Francisco General Hospital emergency department and trauma center data with police data to get a more complete picture of crash incidence and severity in the city.

SFDPH collaborated with SFMTA and SFPD to develop a Vision Zero Traffic Fatality Protocol, to ensure consistency in the definition of Vision Zero fatalities across city agencies.[1] Vision Zero traffic fatalities are reported and mapped monthly on the Vision Zero SF website.

Methodology

Geographic

SFDPH's original methodology to identify HICs predated the Vision Zero initiative. The HICs were initially pedestrian focused. Using five years of SWITRS crash data, SFDPH assigned all pedestrian injury crashes to road segments. Minor injuries received a weight of 1, while severe injuries and

[1] Vision Zero SF, "Vision Zero Traffic Fatality Protocol," San Francisco, 2016.

fatalities were multiplied by 3. Weighted injury counts were aggregated to the nearest intersection and then distributed to the road segments that form the intersection. Using a kernel density map and through analysis of the distribution of weighted scores, the HICs were established by selecting segments with a threshold score of 9 and then aggregating the segments into corridors. A significant amount of professional judgment was required for this process, including consulting SFMTA and local advocacy groups once the initial HICs were identified. Another important step in this process was overlaying the network with the MTC's Communities of Concern index, which showed a disproportionate number of HIC road segments in potentially disadvantaged areas of the city based on areas with relatively higher concentrations of low-income residents, people of color, seniors, and other populations more likely to be dependent on walking and public transit.

SFDPH used this methodology to find HICs for cyclist and vehicle crashes as well. For cyclist crashes, the weighted score threshold was set at 5; for vehicles it was 132. All three networks were then overlaid to arrive at a HIN for Vision Zero. The different thresholds used to assign road segments to an HIC by mode created inconsistency in the HIN, however, which complicated efforts to prioritize investments based on the network.[2] Therefore, SFDPH decided to develop a new methodology.

SPDPH's new methodology simplifies identifying the HIN to a metric based on all KSI (minor injuries are no longer considered). SFDPH now has direct access to police data and San Francisco General Hospital emergency department and trauma center data (see Data Management), which includes very accurate crash location data. SFDPH used an algorithm to "corridorize" the city street network into logical quarter-mile segments and assigned each KSI crash to its corresponding segment. Quarter-mile segments with at least 7 KSI/mile are included in the HIN.

Behavior

As part of the San Francisco Pedestrian Strategy called WalkFirst, an initiative of the Mayor's office completed in 2013, the city identified 12 crash profiles that lead to pedestrian fatalities and severe injuries. This process built off of the original HIC methodology, including both the corridors and, crucially, the intersections identified in the process of selecting the HIC. The WalkFirst team used the collision characteristics data available through SWITRS to find the top

[2] San Francisco Department of Public Health, "Identifying High Pedestrian Injury Corridors for Targeted Safety Improvements," San Francisco, 2011, updated 2013.

three collision profiles for each of the 1,014 intersections in the HIN.[3] Next, WalkFirst began identifying investments to address each collision profile, to guide implementation of the safety plan. A similar process has recently started to identify the top collision profiles for cyclists.

Part of the Vision Zero plan also included the "Focus on the Five" initiative, which used SFPD data on citations and connected it to behaviors known to cause crashes, including speeding, violating pedestrian right-of-way in a crosswalk, running red lights, running stop signs, and failing to yield while turning. SFPD committed to issuing half of traffic citations for these five violations. Additional analyses have since been conducted to understand how potentially broadening the Focus on the Five citation categories may be more responsive to variations in police districts (e.g., a police district with only one stop sign).

Targeted education and enforcement campaigns on driver yielding to pedestrians[4] and speeding[5] have also been developed and implemented in support of Vision Zero, with the initiatives informed by local data analysis and including robust evaluation led by SFDPH.

Data Management

The SWITRS data that SFDPH started out working with suffered from a three-year lag in available data. SFDPH and SFMTA received approval to access SFPD police crash records, including identifying information of people involved in crashes to support record linkage. Currently, SFDPH and SFMTA receive quarterly updates of crash data from SFPD in an Access database. There is a four-to-six-month lag in the crash data transfer from SFPD, including the time required to internally quality assure/quality control the data and geocode it. In the future, SFDPH would like SFPD to record crashes directly into their incident reporting system, which is very robust and should significantly decrease lag time and increase data quality.

SFDPH also now has access to crash victim data from San Francisco's only Level 1 Trauma Center. This data is available with a six-month lag. SFDPH has access to personal identifying information, which enables them to match records between trauma center and SFPD data. They have seen that SFPD data underreports the severity of injuries, as well as an overall underreporting of injuries (particularly non-vehicle crashes). Efforts to update SFPD data with more accurate severity data would be subject to HIPAA requirements; SFDPH is working with city partners to better understand and advance this work.

[3] Chava Kronenberg, et. al., "Achieving Vision Zero: A Data-Driven Investment Strategy for Eliminating Pedestrian Fatalities on a Citywide Level," *Transportation Research Record: Journal of the Transportation Research Board*, no. 2519 (2015): 146–56, doi:10.3141/2519-16.

[4] Michael Cabanatuan, "Campaign Suggests Way to Get More Drivers to Stop for Pedestrians," *SFGate,* September 13, 2015, accessed August 16, 2017, http://www.sfgate.com/bayarea/article/Study-suggests-way-to-get-more-S-F-drivers-to-6497197.php#photo-8449849.

[5] Michael Cabanatuan, "Beware SF Drivers: Yearlong Crackdown on Speeding Kicks Off," SFGate, September 30, 2016, accessed August 15, 2017, http://www.sfgate.com/bayarea/article/Beware-San-Francisco-drivers-Year-long-crackdown-9456672.php.

SFDPH maintains the TransBASESF.org webmap, which pairs Vision Zero-related data like the HIN, SWITRS, and SFPD crash data with relevant datasets covering factors like the built environment, demographics, and institutions. The webmap is built using open-source products and is available for the public to view. The system is enabled with open database connectivity, which enables users to access the data in the underlying database in both GIS and table/spreadsheet forms. This functionality is available to SFDPH staff, other city departments, and the general public. A detailed description of the underlying architecture of the webmap was published in a 2016 Transportation Research Board article.[6]

LOS ANGELES

Introduction

Contact:	Tim Black, Data Analyst, LADOT
Interview Date:	3/22/17
Publication:	Vision Zero Los Angeles (August 2015)

Primary Metric

- bicycle and pedestrian KSI.

Primary Metric Data Sources

- SWITRS crash data (2009–2013);
- Community Health and Equity Index (an environmental justice index); and
- demographic data.

Additional Data Collected

- community input on problem locations.

Common Data Not Used

- trauma center and hospital data;
- cross-section or functional class data; and
- traffic volume data.

[6] Devan Morris and Megan Wier, "Geospatially Enabled Database for Analyzing Traffic Injuries in San Francisco, California," *Transportation Research Record: Journal of the Transportation Research Board,* no. 2595 (2016): 40–49, doi:10.3141/2595-05.

LADOT identified their most vulnerable users by looking at who was most affected by crashes and found that pedestrians and cyclists are overrepresented among crash victims that are either killed or severely injured: 15 percent of all collisions but about 50 percent of all crash deaths. This justified elevating pedestrian and bicycle crashes over vehicle-only crashes, but they were not removed entirely from the analysis, just weighted less. Similarly, LADOT incorporated feedback from Vision Zero stakeholders that identified severity, vulnerability, and social equity as the most important factors to address in road safety and therefore assigned weights to these priorities. This analysis is outlined in greater detail below.

Methodology

Geographic

LADOT mapped KSI data across the city and used the results to identify a HIN that would account for the majority of bicycle and pedestrian crashes resulting in KSI. This was described as an iterative process that relied heavily on local knowledge and did not use a consistent, data-driven methodology to establish where road segments would end or a minimum crash density for inclusion on the list. They settled on 386 corridors, representing 6 percent of Los Angeles's street miles and inclusive of 65 percent of all deaths and severe injuries involving people walking or biking.

The Vision Zero action plan identified an initial benchmark of reducing traffic deaths by 20 percent by the end of 2017. To reach this goal, 40 priority corridors within the HIN were identified as those that could bring the biggest improvement in the shortest amount of time. These corridors were identified through an intersection scoring method, developed with the help of consultants and informed by the priorities of members of the Vision Zero Alliance, a local advocacy group with a broad constituency. They identified severity (KSI), vulnerability (children and senior citizens), and social equity (locations within a community with a top 25 percent score on the Los Angeles Health Atlas's Community Health and Equity Index) as the top priorities and set the intersection scoring to reflect this.

LA HIN intersection formula:

Fatality (x1.5)* + Severe Injury** + Child or Senior*** + Target Community**** = Intersection Score

*weighted higher for severity
**raw value
***0 or 1 if a child or senior was present
****0 or 1 is the location was in a target community

The top scoring intersections were then mapped and used to arrive at the top 40 priority corridors identified in working sessions with LADOT staff.

Behavior
Part of identifying the most vulnerable users through crash data included a robust collision profiling analysis to characterize collision patterns. The project's consultant performed a statistical cluster analysis on characteristics of collisions and environmental characteristics related to collisions. Through the analysis and further investigation suggested by LADOT staff, the consultant work resulted in 12 statistically significant collision profiles, or behaviors, that factor into a substantial number of crashes that result in KSI. LADOT reported that the collision profiles were somewhat useful in the initial stages of the action plan but have not been useful in ongoing implementation strategy, did not influence the investment priorities, and will not be updated.

Data Management

LADOT relies on the SWITRS for crash data. SWITRS is provided to LADOT in an Access database, which LADOT uses to populate their RoadSafeGIS software (this recently replaced the Data Viewer software they previously used). In the past, SWITRS only made relatively old (one to two years) crash data available. SWITRS has made strides to produce data within six months of the end of the year. In addition, LAPD is beginning to pilot electronic reporting, which may be reportable directly to LADOT and also allows them to add fields not currently tracked by SWITRS. LADOT has a Vision Zero page on the city's public facing GeoHub, which provides detailed information on crash data, analysis, and the HIN. Data is shared internally using the city's internal GIS. Implementation projects are coordinated through ongoing Vision Zero committees.

PORTLAND

Introduction

Contact: Clay Veka, Vision Zero Project Manager, PBOT
Clinton Chiavarini, Senior GIS Specialist, Metro

Interview Date: 3/23/17

Publication: Vision Zero Action Plan (December 2016)

Primary Metric

- all bicycle and pedestrian crashes; KSI crashes for vehicles.

Primary Metric Data Sources

- Oregon Department of Transportation (ODOT) crash data (2004–2013); and
- traffic volume data.

Additional Data Collected

- Communities of Concern (an environmental justice index); and
- trauma center and hospital data (collected but not used).

Common Data Not Used

- crowdsourced problem location data; and
- cross-section or functional class data.

PBOT took a modal approach to its Vision Zero analysis, identifying high crash networks for pedestrians, bicycles, and vehicles separately. The networks were then overlaid to arrive at an overall High Crash Network for the city. To ensure that the Vision Zero plan addressed equity issues, PBOT overlaid the High Crash Network with the Communities of Concern index and pushed for investments to be made in those areas first. PBOT and the local MPO, Metro, also explored incorporating a risk analysis and hospital data into their Vision Zero plan, but these efforts had mixed results (see "Supporting Information").

Methodology

Geographic

PBOT developed a High Crash Network for corridors and for intersections. The corridor selection analyzed crash data by mode. Vehicle crashes were included in the analysis if they resulted in a KSI. All pedestrian and bicycle crashes were included in the analysis, regardless of severity. Crashes for each mode were aggregated to the corridor level (a "corridor" is all street segments that share a name) and totaled. PBOT then identified the top 20 corridors for vehicle, pedestrian, and bicycle crashes. Many corridors appeared on all three lists, and the combined list included 30 corridors, 8 percent of Portland's streets and accounting for 57 percent of all fatal crashes from 2004 to 2013. These streets make up the High Crash Network.

PBOT also folded an existing intersection prioritization method into the Vision Zero plan using crash data for all modes together. This method ranks intersections based on a score that accounts for (1) total number of crashes in the intersections; (2) collision rate, which incorporates average daily traffic; and (3) value of collisions, based on the National Safety Council's monetary crash values. The top 30 intersections from this methodology were included in the High Crash Network. All 30 intersections happened to be on the corridors previously identified.

PBOT also incorporated TriMet's Communities of Concern index to identify underserved neighborhoods. These neighborhoods are overrepresented on the High Crash Network (both corridors and intersections) and are a focus for investment.

Behavior

PBOT analyzed 10 years of crash data to determine the primary factors in deadly and serious injury crashes. They found that 91 percent of these crashes involved speed, impairment, and/or dangerous behaviors (behaviors that generally arise from aggressive or distracted driving). These three factors became the primary behavioral targets of the Vision Zero plan.

Data Management

In Oregon, fatal crashes are reported by the police, while more minor events are self-reported by the parties involved to the DMV, which then reports them to ODOT. There is a significant time delay (1+ year) until ODOT is able to make complete information available, although they do issue updates in the interim. Data received from ODOT is geocoded and mapped in-house by PBOT. PBOT performed data analysis for the Vision Zero plan in GIS. PBOT also published the 2005–2014 crash data used to identify the High Crash Network online using an Esri ArcGIS Online map.

Supporting Information

Metro, the Portland area MPO, has also gone through a prioritization process to identify high crash corridors throughout the region. Metro developed a weighted metric to identify high crash corridors. Like PBOT, Metro looked at only KSI for vehicle crashes and at all crashes for bicycle and pedestrian crashes. They reasoned that in the case of bicycle and pedestrian crashes, severity is dictated much more by luck than in the case of vehicle crashes. Crash events were mapped and linked to Metro's regional transportation network in GIS, which consists primarily of arterials. Bicycle and pedestrian crashes were weighted by severity; vehicle crashes were limited to KSI, and these were weighted the same. The weighted sum of crashes along a corridor was then normalized by length and ranked. This produced four outputs: the corridors that account for 50 percent of vehicle crashes, the corridors that account for 50 percent of pedestrian crashes, the same for bicycle crashes, and the corridors that account for 60 percent of all crashes. This methodology was still under review at the time of the interview.

Both PBOT and Metro are interested in developing more proactive risk analysis models rather than relying on existing crash trends to identify priority locations for Vision Zero implementation. PBOT explored a risk analysis model for pedestrian and bicycle crashes. They assigned bicycle and pedestrian crash density values to road segments using "crashes per centerline mile" based on 10 years of crash data. Then values were assigned to road segments based on characteristics that included traffic signal density, number of lanes, speed limit, bicycle network facility type, and average sidewalk width. The analysis was performed on road segments classified as "Neighborhood Collector" or higher. A major issue in the analysis was the incompleteness of the data. Because the scoring methodology added points based on the presence of the five road characteristic factors, roads with missing data necessarily scored lower.

PBOT is also interested in using trauma center data to get a more complete picture of crashes. The Oregon Trauma Registry offered a promising dataset of serious injuries; however, the data was difficult to match with crash data because of its focus on health data, while ODOT focuses on crash characteristics. This hampered efforts to determine definitively if there were discrepancies between the datasets, which could have indicated underreporting of crashes. PBOT did use the data to better understand intoxication trends in crash victims and found some racial disparities in pedestrian crash victims.

WASHINGTON, DC

Introduction

Contact:	Jonathan Rogers, Transportation Management Specialist, DDOT
Interview Date:	3/10/17
Publication:	Vision Zero: A Plan of Action (December 2015)

Primary Metric

- pedestrian and bicycle deaths/arterials with multiple total fatalities.

Primary Metric Data Sources

- MPD crash data (2010–2014); and
- crowdsourced problem location data.

Additional Data Collected

- trauma center and hospital data (recent initiative, see "Data Management"); and
- cross-section or functional class data.

Common Data Not Used

- equity/demographic data (e.g., an environmental justice index); and
- traffic volume data.

DDOT has a unique role as the transportation authority for both the city and "state" (the District of Columbia). DDOT works closely with MPD on crash data and receives regular, daily updates of data. Their Vision Zero analysis was an iterative process that considered both crash data and crowdsourced problem location input. Moving forward, DDOT is exploring developing a risk analysis model based on multiple inputs like land use and physical attributes, in addition to crash data and public perception input.

Methodology

Geographic

DDOT identified their High Crash Corridors through an iterative process focused on capturing the majority of pedestrian and bicycle fatalities. DDOT created a kernel density map of five years of crash data across the city, including pedestrians, vehicles, and bicycles. In addition, DDOT produced kernel density maps by mode, based on both crash rate and safety perception drawn from a public outreach Esri webmap. These maps helped to identify 15 arterial corridors with multiple total fatalities. These arterials account for over 50 percent of pedestrian, bicycle, and motorcycle fatalities. When automobile fatalities are factored in, the High Crash Corridors account for 40 percent of all fatalities from 2010 to 2014.

Behavior

DDOT performed a robust analysis of behaviors that lead to crashes after publishing the Vision Zero plan, rather than performing this analysis prior to releasing the plan. DDOT did report on the results of their public engagement, however, including the behaviors that people identified as their top concerns. This included speeding, distracted driving, and ignoring traffic signals (including red-light running and crossing against the light).

Data Management

DDOT has developed a robust data management process. MPD reports crashes directly to DDOT. Since shifting to electronic reporting, DDOT receives crash data every 24 hours from MPD in a raw data format. They have a proprietary software interface called TARAS that produces standardized reports from this raw data. DDOT is responsible for geocoding the data and pushing it onto the DC Open Data Portal. Internally, DDOT uses a version of the open data portal to share data and analysis throughout the department. DDOT has also begun publishing moving and non-moving violations data on the data portal as a result of Vision Zero.

DDOT is currently working with the Department of Health (DOH) on incorporating trauma center data into their Vision Zero analysis. This work was triggered by a new trauma center data repository, which DOH recently completed.

Supporting Information

DDOT developed the Crash Composite Index (CCI) for identifying priority intersections prior to adopting Vision Zero. The CCI is used in DDOT's Highway Safety Improvement Program (HSIP) implementation and is built into the standardized reports produced by TARAS. The CCI assigns each intersection three rankings, one each for crash severity, crash rate, and crash frequency.[7] Crash frequency refers to the total number of crashes at each intersection over a defined period. The intersections with the greatest number of crashes are the most highly ranked. Crash rate is calculated by dividing the average crashes per year by the traffic volume entering the intersection, to account for vehicle exposure. Crash severity is based on the types of injuries experienced at an intersection and ranks most highly those intersections with the most serious injuries and fatalities. The CCI then combines the three ranks for each intersection into a single score with crash severity weighted 50 percent and crash rate and crash frequency both weighted 25 percent. DDOT uses this ranking to determine where to make HSIP investments around the district. The CCI was not incorporated into Vision Zero, however, because the lack of quality pedestrian and bicycle data skews the measure toward locations with high vehicle volume but not necessarily toward locations where exposure is greater for pedestrians or cyclists.

SEATTLE

Introduction

Contact:	Jim Curtin, Senior Transportation Planner, SDOT Allison Schwartz, External Outreach Advisor, SDOT
Interview Date:	3/27/17
Publication:	Vision Zero (February 2015)

Primary Metric

- total KSI density.

Primary Metric Data Sources

- Seattle Police crash data (2012–2016);
- cross-section or functional class data (general road characteristics); and
- traffic volume data.

Additional Data Collected

- Race and Social Justice Initiative data (an environmental justice index);
- crowdsourced problem location data; and

[7] DDOT, "Highway Safety Improvement Program Methodology," unpublished memorandum.

- ongoing analysis incorporates data on land use, lighting, topography, transit, and more.

Common Data Not Used

- trauma center and hospital data.

Seattle is lucky to already be a very safe city in terms of traffic-related KSI. It ranks next to Sweden—the birthplace of Vision Zero—in road fatalities per 100,000 people. Seattle's Vision Zero efforts have focused strongly on the physical characteristics of the road. Its initial prioritization scheme started with physical characteristics but ultimately weighted them lightly versus crash incidence. Its more recent BPSA focuses much more on road characteristics as the guiding metric to prioritize investments. Seattle also has a robust data management process with very rapid access to new crash data.

Methodology

Geographic

SDOT identified priority corridors for their Vision Zero plan through a two-part analysis that started looking at roadway characteristics and then applied collision history. This resulted in an analysis of major corridors with weighted indicators:

- physical characteristics (10 percent):
  - normalized length ratio (30 percent);
  - normalized average vehicle volume ratio (40 percent);
  - normalized segment/intersection count ratio (10 percent); and
  - normalized average street width ratio (20 percent).
- total collision density (30 percent); and
- total severe/fatal collision density (60 percent).

In the first part of the analysis, road characteristics were used to identify the major corridors in the city based on street name (versus short arterial segments) and to prioritize the ones with maximum exposure to all modes. Street length, street segment count (a proxy for intersection density), vehicle volume, and average street width were normalized versus the maximum value and weighted using the weights listed above under "physical characteristics." The top 100 corridors moved to the next phase.

In the second phase, SDOT analyzed both total crashes (excluding property damage only) and KSI crashes by corridor, both by overall count and by crash density, again normalized by the highest value. (Crash density is a measure of crashes normalized by segment length.) SDOT determined that the density measure was more useful than the count for identifying priority corridors and incorporated these into the weighting system.

SDOT incorporated professional judgment into this largely data-driven approach by ensuring that the priority corridors satisfied equity concerns and were geographically distributed across the city. Intersections were not prioritized at this stage of the Vision Zero plan. Intersections were analyzed in the BPSA (see "Supporting Information").

Behavior

The BPSA did a rigorous analysis of collision profiles and their connection to road geometry and built environment factors.

Data Management

SDOT is responsible for collecting, maintaining, and mapping police crash data. Incidents are recorded by the police directly into Hansen, the city's asset and incident management database. Crash data is available approximately two weeks after the event occurs. SDOT pulls standardized queries on crash data from Hansen using Collision Cube, a proprietary interface. This data can then be mapped in GIS for further analysis. SDOT also has access to police citation data through another database used by the police called Sector. Access to this database was gained in the transition to electronic reporting.

SDOT is interested in incorporating health data into its Vision Zero analysis. The initial proposal for the BPSA included a project to link a wide variety of data sources, including health, police, and judicial data, but this proved very difficult. A more limited partnership is being pursued with the University of Washington Trauma Center to incorporate health data into Vision Zero.

Supporting Information

The BPSA uses a robust, multivariate regression model to help SDOT become more proactive, rather than reactive to crash risk. The analysis will inform investment projects connected to Vision Zero going forward. At its most basic, the analysis involved focusing on the most common types of pedestrian and bicycle crashes (e.g., opposite-direction bicycle crashes in intersections) and then running a multivariate regression on the crash profile data against a number of variables, mostly relating to the built environment or road characteristics. Examples include road class, presence of bike facilities, proximity to commercial land use, and slope. A major limitation, however, is the lack of sufficient volume data to incorporate into the analysis.

Once statistically significant variables were identified, the consultant identified locations (mostly intersections) that scored high on the variables that correlated strongly with crashes. The results have already been used to invest in safety improvements at locations where pedestrian and bike crash incidence is not currently very high but is likely due to avoidance of the area rather than to its inherent safety.

BOSTON

Introduction

Contact:	Charlotte Fleetwood, Senior Transportation Planner, BTD
Interview Date:	3/24/17
Publication:	Vision Zero Boston Action Plan (February 2016)

Primary Metric

- all injury crashes.

Primary Metric Data Sources

- EMS data (three years); and
- BPD traffic-related homicide data (three years).

Additional Data Collected

- crowdsourced problem location data (collected after action plan was developed); and
- equity/demographic data (e.g., an environmental justice index).

Common Data Not Used

- trauma center and hospital data (only EMS data was used);
- cross-section or functional class data; and
- traffic volume data.

BTD identified two priority corridors and two pilot zones for a Slow Streets program in the run-up to publishing their Vision Zero plan. Rather than rely on police crash report data from the state DOT as its starting point like most other cities interviewed, BTD used data from Boston EMS as a proxy for crash injury data, combined with homicide data from the BPD (the BPD's Homicide Unit is charged with investigating fatal collisions). BTD worked closely with EMS and BPD to identify the priority locations.

Methodology

Geographic

Two Priority Corridors were identified as the initial focus of Vision Zero-related investments through a process that relied on collaboration informed by data. BPD and EMS independently identified 10 high crash locations each; then, through comparison, 13 rose to the top. The process involved a review of available crash data (three years). Road segment limits were decided on by changes in crash density combined with logical breaking points like next nearest intersection. The process was not purely scientific but rather informed by professional knowledge of the local system.

The first corridor, Massachusetts Avenue, had seven of the 13 high crash locations. The second, referred to as Codman Square, is actually two corridors, Norfolk Street and Talbot Avenue, which meet in Codman Square. This location was selected because the area is considered underserved, and BTD wanted to include an equity consideration.

BTD's Neighborhood Slow Streets program focuses Vision Zero-related investments into a small neighborhood area; the program was inspired by a similar initiative in New York City. The pilot locations were selected as the result of a process that relied on professional knowledge of the city and prior community engagement. The Talbot-Norfolk Triangle zone was selected because the community provided dramatic recent evidence that dangerous speeding was happening in this area. The Stonybrook neighborhood was chosen as the second pilot zone because of documented speeding concerns, and a developer-led project was already underway that included some safety improvements and funding to the city for additional traffic calming. This made the neighborhood a logical and easy fit into the Vision Zero plan.

A Neighborhood Slow Streets application process is being used to select the next two zones. The criteria for selecting the next zones include the concentration of vulnerable users (children and elderly). An equity measure is built into the program, as the evaluation attaches more weight to neighborhoods with vulnerable populations and a history of injury crashes. There has been widespread interest in the program. In addition, it has been an effective tool for raising the profile of the Vision Zero initiative.

Behavior

The plan's global focus on speeding and vulnerable users was not the result of analysis of local data but instead was based on research in the transportation literature and on knowledge of what was done in other cities.

Data Management

BTD used data from the BPD and EMS in its Vision Zero analysis. EMS data is the more consistent and comprehensive dataset of the two. It has a large number of data points and is updated frequently, making it very reliable and useful. EMS data is automatically transferred to the Department of Innovation Technology (DOIT). Although EMS collects data on whether the call resulted in Basic Life Support (BLS), Advanced Life Support (ALS), onsite fatality, or patient refusals, this data is not publicly shareable due to HIPPAA constraints.

Police data on fatal crashes is obtained from BPD's homicide division, and the information is mapped in GIS. No crash data is made available from the police or the state in an electronic format. This data is for traffic fatalities that occurred only on city-owned streets as reported by BPD. Data for state-owned roadways will be included in the future. Interstate roadway data was not included, and no plans to include it were mentioned.

Supporting Information

BTD has started to employ the Massachusetts Department of Transportation's (MassDOT's) crash cluster methodology to identify priority locations by mode. This process employs a "search-and-merge" methodology that applies a certain radius around each crash and merges any overlapping radii into clusters.[8] Clusters are then ranked using a weighted scoring method (10 for fatal crashes, 5 for injury crashes, and 1 for property damage or non-reported crashes). Clusters are manually checked to ensure they are located at an intersection and not an interchange; interchange locations are excluded. The intersection analysis is based on three years of crash data.

The same cluster analysis is performed on collisions between motorists and other motor vehicles, pedestrians and motor vehicles, and between cyclists and motor vehicles. The crash radius varies depending on the type of crash. If it involves only motorists, the radius is 25 meters. If pedestrians or cyclists are involved in a crash, the radius is increased to 100 meters; this results in larger crash clusters that do not tend to focus on a specific intersection. Also, to increase the available data for the analysis, 10 years of crash data is desired.

LONDON

Introduction

Contact:	Simon Bradbury, Senior Strategy and Planning Manager, TfL Joe Stordy, Research and Data Analysis Team, TfL
Interview Date:	4/18/17
Publication:	Safe Streets for London (June 2013)

Primary Metric

- KSI/billion passenger-kilometers traveled.

Primary Metric Data Sources

- STATS19 crash data (2008–2011); and
- London Travel Demand Survey (LTDS).

Additional Data Collected

- equity/demographic data (TfL reports on indices of multiple deprivation);
- Hospital Episode Statistics (HES); and
- Department of Transport traffic volume data.

[8] MassDOT, "2014 Top Crash Locations Report," 2016.

Common Vision Zero Data Not Used

- crowdsourced problem location data; and
- cross-section or functional class data.

TfL published SSfL in June 2013. The plan employs a robust data analysis of vulnerable users, which is also the focus of this memo. By measuring both the KSI incidence and the KSI risk by mode and other demographic characteristics, TfL is better able to target their investments and goals for reducing KSI in London.

Methodology

Geographic

TfL employs a methodology that predates the SSfL initiative to identify priority locations for safety improvements. Geocoded collision data is assigned to a network of links (road segments) and nodes (intersections). Nodes include the roadway within a custom radius of each intersection. Crashes on links are normalized by distance. A link or node is considered a high priority if it is at least two standard deviations from the mean.

Going forward, TfL is interested in building a predictive model to identify places that are dangerous but may not generate many crashes because the most vulnerable users avoid them.

Behavior

A key component of the SSfL plan was a robust analysis of STATS19 crash data along with the LTDS, an annual rolling survey of travel behavior for London households. Pairing these two datasets allowed TfL to establish a risk measure, which was based on the KSI rate per billion passenger-kilometers. The LTDS offers origin-destination data for Londoners over the age of five but lacks data on non-commuting-related travel and travel by non-Londoners within the city. TfL developed a rough estimate of citywide passenger-kilometers traveled by mode using the straight line distance between the origins and destinations (TfL now uses the network distance, rather than straight line). By limiting the crash data to events involving parties with London postcodes, TfL was able to align the datasets and use the billion passenger-kilometers traveled metric derived from the LTDS to normalize KSI from the STATS19 crash data by mode. This created the risk metric, which TfL paired with the absolute KSI rate by mode to identify vulnerable users by overall KSI and by the KSI rate.

This analysis reveals useful trends. For instance, although car drivers, cyclists, and motorcyclists all experience a similar number of total KSI casualties, they experience far different risk as a result of how many more passenger-kilometers are traveled by car.

TfL did not limit this analysis to modes but also explored the risks associated with different ages, times of day, gender, and ethnic minority status. They were also able to apply the analysis geographically across London's 33 boroughs, which revealed that while a borough like Westminster may have the highest number of KSI casualties, its risk rate is actually well below average. Statistical significance, however, begins to factor in as a major limitation to the data as it is sliced into smaller subsets.

Data Management

TfL uses the STATS19 dataset, which contains crash data reported by the Metropolitan Police, as well as some self-reported crashes. TfL is currently working with the Metropolitan Police to create a near-live dataset on crashes. In addition, TfL is working to make it easier for people to self-report crashes and now has an online self-reporting option. In the United Kingdom, any crash may be reported—not only those involving vehicles—though non-vehicle crashes are likely severely underreported.

SSfL-related analysis is made available to the 33 borough governments in London via an online portal. In addition to maps of KSI incidence and other data points, TfL also provides online dashboards for boroughs to follow their progress on various measures set forth through SSfL.

TfL is currently working to match HES (hospital) data to the STATS19 data. Lacking a common ID, however, has created challenges. TfL has been able to link enough data points to see major discrepancies in the severity of injuries as reported by the two datasets. Since they cannot match all the data, though, it is not possible to make definitive conclusions about underreporting.

SWEDEN

Introduction

Contact:	Matts-Ake Belin, Project Leader, Swedish Transport Administration
Interview Date:	5/4/17
Publication:	Analysis of Road Safety Trends (2014)

Primary Metric

- KSI nationwide.

Primary Metric Data Sources

- cross-section data.

Additional Data Collected

- police crash data;
- hospital data; and
- traffic volume data.

Data Not Used

- crowdsourced problem location data; and
- equity/demographic data.

Sweden is the birthplace of Vision Zero; it was instituted nationwide following an act of Parliament in 1997. Now in place for 20 years, Vision Zero has advanced considerably in Sweden. Rather than focus on where fatal and severe injury crashes occur, the STA is now focused entirely on proactively preventing crashes by addressing the remaining parts of the roadway system where they have not upgraded facilities in line with Vision Zero-related designs. They rely heavily on many years of experience and research dating to the 1960s to install treatments and pursue policies nationwide that are known to lower the kinetic energy present when crashes do occur (e.g., reduce speed and severity).

Methodology

Geographic

Although part of the original Vision Zero plan, STA has since moved away from "black spot" (small area or intersection) programs that identify priority locations based on past crash experience. Instead, they now create hierarchies of crash propensity locations. STA gathers data on the system itself and ranks corridors in red, yellow, or green categories according to their design safety. Part of this analysis still involves crash data, but overall STA is moving toward a broader approach, which addresses pieces of the system that are not as safe as they could be. By continually building on research about their system, STA is able to identify which system components are safest.

STA has developed a method to address safety concerns called OLA, for "objective facts, list of solutions, and addressed actions."[9] The process is intended to isolate traffic safety problem areas and develop concrete solutions. The OLA process focuses primarily on behavioral or systemwide problem areas like alcohol use and bus traffic.

Unlike many cities in the United States, STA does not incorporate a social, economic, or race equity component of any sort in their Vision Zero plan. In addition, although STA does focus on vulnerable road users, single-cyclist crashes are underrepresented in their work. This is in part because STA implements the nationwide Vision Zero program and largely focuses on rural roads. Individual cities tend to implement the more urban strategies, which are more likely to have a pedestrian or cyclist focus. They also often include public input in ways that STA is not engaged in. The City of Gothenburg, for instance, adopted a Vision Zero plan in 2009 focused on 2020.

In order to meet its ultimate goal of eliminating traffic fatalities, STA has set interim benchmarks for achieving Vision Zero by 2040. STA's goals for 2020 include halving fatalities from the 1997 figure (when the Vision Zero legislation passed) and dramatically increasing the share of traffic volume that operates within posted speed limits. STA tracks whether these benchmark figures are trending in the right direction and at the rate needed to meet their 2020 goals.

As of 2016, STA reported that Vision Zero progress had largely stalled with traffic fatalities beginning to increase again. This prompted a renewed push to

[9] "OLA—A Systematic Working Method," Trafikverket, April 7, 2015, accessed August 16, 2017, http://www.trafikverket. se/en/startpage/operations/ Operations-road/vision-zero-academy/Vision-Zero-and-ways-to-work/ola/.

tackle Vision Zero goals, including a relaunch of the campaign by the Swedish Government.[10]

Data Management

All police crash data and all health records associated with a crash feed into a single database called STRADA, which STA uses to identify and analyze crash problems. Working with hospital data allows STA to identify crashes that were not captured on police reports, often involving pedestrians or bicyclists who only went to the hospital and did not call the police. Also, the severity of each crash is verified by health professionals and does not rely only on what police report on the scene. Every fatal crash is investigated by a crash analysis team that goes to the site of the crash to gather data and learn more about the circumstances. The crash analysis team includes a range of experts, from road engineers to healthcare professionals.

[10] "The Number of Fatalities on Swedish Roads is Not Decreasing," Trafikverket, May 11, 2017, accessed August 16, 2017, http://www.trafikverket.se/en/visionzero/vision-zero-conference-2017/news/2017/2017-05/the-number-of-fatalities-on-swedish-roads-is-not-decreasing/.

APPENDIX C: CDART SAMPLE REPORT

RSA ERIE AVE 0020/0000 TO 0070/0020

Date Range: 1/1/2004 to 12/31/2006

Area of Interest: (In County 67 On State Route 1004(P) Between Segment 0020 Offset 0 and Segment 0070 Offset 20)

USER_ID/QUERY ID: lkubli/ 0620080310003

PENNDOT

MONTH OF YEAR

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
CRASHES	8	11	25	12	14	26	13	14	16	17	17	15	188
PCT	4%	5%	13%	6%	7%	13%	6%	7%	8%	9%	9%	7%	100%

DAY OF WEEK

	SUN	MON	TUE	WED	THR	FRI	SAT	
CRASHES	19	24	30	31	26	30	28	188
PCT	10%	12%	15%	16%	13%	15%	14%	100%

HOUR OF DAY

	00	01	02	03	04	05	06	07	08	09	10	11	12
CRASHES	7	4	4	4	2	1	6	9	8	6	10	5	8
PCT	3%	2%	2%	2%	1%	0%	3%	4%	4%	3%	5%	2%	4%

	13	14	15	16	17	18	19	20	21	22	23	99	
CRASHES	3	9	17	17	11	11	6	13	7	3	4	13	188
PCT	1%	4%	9%	9%	5%	5%	3%	6%	3%	1%	2%	6%	100%

YEAR

	CRASHES	PCT
2004	80	42%
2005	47	25%
2006	61	32%
TOTAL	188	100%

COLLISION TYPE

	CRASHES	PCT
ANGLE	61	32%
REAR END	43	22%
PEDESTRIAN	29	15%
HEAD ON	18	9%
HIT FIX OBJ	16	8%
SAME DIR SS	16	8%
OPP DIR SS	5	2%
TOTAL	188	100%

CRASH SEVERITY LEVEL

	CRASHES	PCT
FATAL	1	0%
MAJOR	7	3%
MODERATE	34	18%
MINOR	82	43%
UNK SEVERITY	39	20%
UNK IF INJURED	8	4%
PDO	17	9%
TOTAL	188	100%

SEVERITY COUNT

	PERSONS
FATALITIES	1
MAJOR	7
MODERATE	42
MINOR	134
UNK SEVERITY	74
UNK IF INJURED	55

DRIVER ACTIONS

	ACTIONS	PCT
NO CONTRIBUTING ACTION	151	38%
UNKNOWN	109	27%
OTHER IMPROPER DRIVING	30	7%
IMPROPER/CARELESS TURN	14	3%
RUNNING RED LIGHT	9	2%
DRIVER WAS DISTRACTED	8	2%
TOO FAST FOR CONDITION	8	2%
SUDDEN SLOWING/STOP	7	1%
TAILGATING	7	1%
CARELESS PASS/LN CHNG	6	1%
MAKING ILLEGAL U-TURN	6	1%
AFFECTED PHYSICAL COND	5	1%
OTHERS	36	9%
TOTAL	396	100%

VEHICLE TYPE

	VEHICLES	PCT
AUTOMOBILE	266	73%
VAN	23	6%
SMALL TRUCK	16	4%
SUV	16	4%
LARGE TRUCK	13	3%
MOTORCYCLE	8	2%
BUS	8	2%
UNK VEHICLE	6	1%
PEDALCYCLE	4	1%
OTHER VEHICLE	2	0%
TOTAL	362	100%

ROAD CONDITION

	CRASHES	PCT
DRY	143	76%
WET	43	22%
OTHER	2	1%
TOTAL	188	100%

ILLUMINATION

	CRASHES	PCT
DAYLIGHT	115	61%
STREET LIGHTS	61	32%
DUSK	5	2%
DARK	3	1%
DAWN	1	0%
OTHER	1	0%
UNK	1	0%
UNK LIGHTING	1	0%
TOTAL	188	100%

WEATHER

	CRASHES	PCT
CLEAR	142	75%
RAIN	37	19%
UNK	5	2%
SNOW	2	1%
OTHER	1	0%
SLEET	1	0%
TOTAL	188	100%

ENVIR/ROADWAY FACTORS

	FACTORS	PCT
NONE	152	77%
UNKNOWN	19	9%
SLIPPERY ICE/SNOW	14	7%
OTHER WEATHER COND	6	3%
OTHER RDWY FACTOR	2	1%
WINDY CONDITIONS	2	1%
OTHER ENVIR FACTOR	1	0%
SUDDEN WEATHER COND	1	0%
TOTAL	197	100%

IMPORTANT: This traffic engineering and safety study is confidential pursuant to 75 Pa. C.S. §3754 and 23 U.S.C. §409 and may not be disclosed or used in litigation without written permission from PennDOT.

CDART - CRASH SUMMARY REPORT (09-06)

Print Date: 3/10/2008:

PHILADELPHIA CRASH STANDARDS AND RECOMMENDATIONS

PUBLICATION NUMBER	17068
DATE PUBLISHED	December 2017
GEOGRAPHIC AREA COVERED	City of Philadelphia
KEY WORDS	Crash data, Philadelphia, database, High Injury Network, Vision Zero, process, data management, crash analysis, safety

ABSTRACT

The City of Philadelphia engaged the Delaware Valley Regional Planning Commission (DVRPC) to investigate ways to evolve the analysis and management of crash data by City departments. DVRPC found that City agencies currently use three distinct databases of crash data: an Access database of the Pennsylvania Department of Transportation's (PennDOT's) crash data, a geodatabase populated with the same PennDOT data, and a separate geodatabase populated with police crash data obtained directly from the Philadelphia Police Department and maintained by the Philadelphia Streets Department. Based on interviews with eight cities' and countries' transportation agencies, DVRPC made recommendations for using crash data to develop a High Injury Network to inform the City's Vision Zero plan and for adapting the City's crash data management and analysis to be in line with three primary goals: centralization, standardization, and ease of use.

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